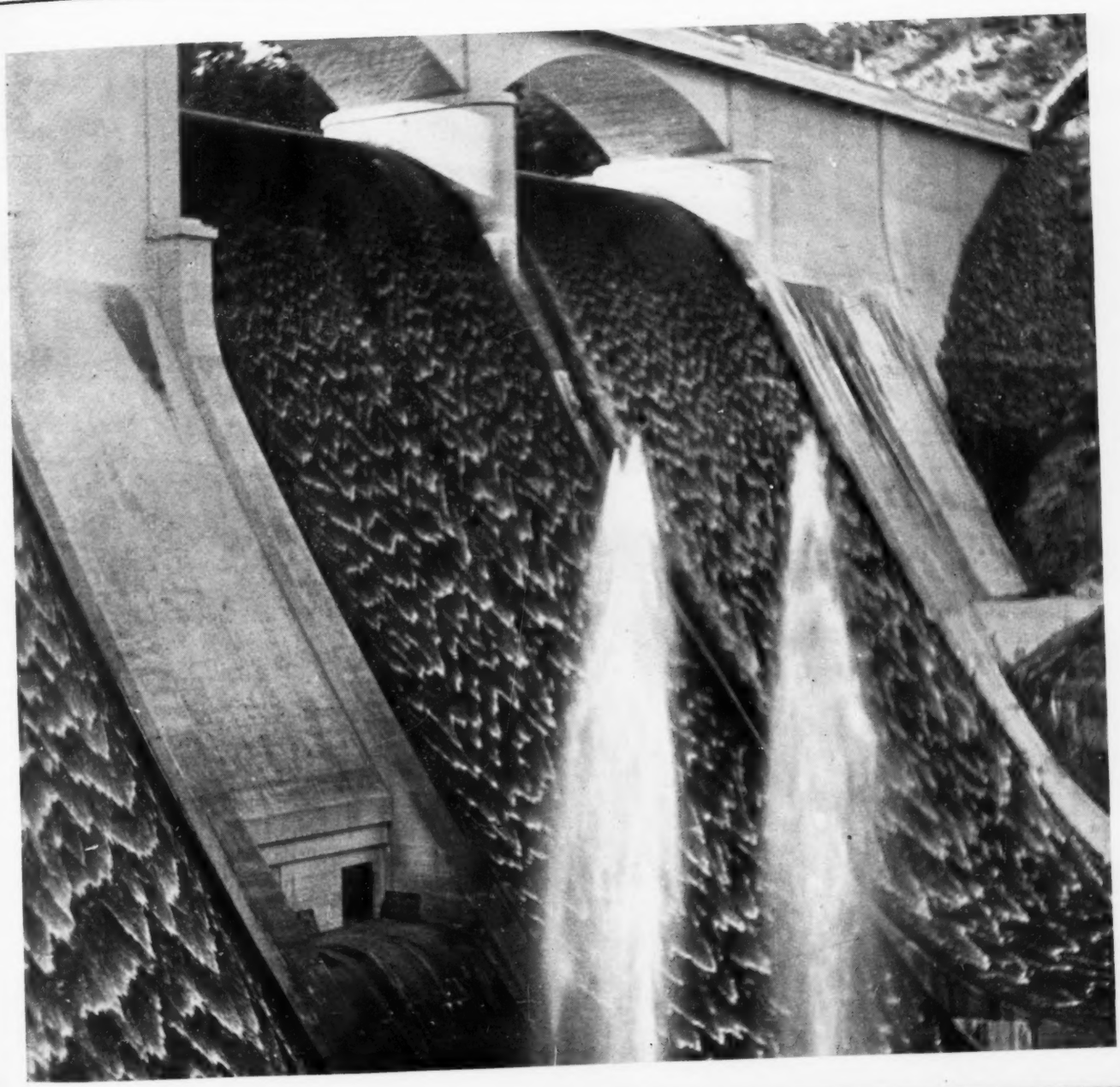
# WATER WORKS AND SEWERAGE

January, 1935 — Editor — Vol. LXXXII. No. 1



# More than seven million feet sold

Recent installation of Super-de Lavaud Pipe at Pelham, New York

## *The Margin of Protection Against Damage in Handling has been Doubled*

Few products face the hazards of damage in transit, handling and distribution that cast iron pipe encounters.

By doubling the impact-resistance of Super-de Lavaud Pipe we have increased its inherent protection against these hazards to a point where they become a negligible factor. In the 22 months we have been shipping Super-de Lavaud Pipe, damage between plant and underground has been almost unknown. Yet during this period we have sold *more than seven million feet.*

Protected to the maximum against damage *above* ground, this tougher, more ductile pipe with doubled impact strength renders super-service *under* ground. It is made by a patented process in which the pipe is centrifugally cast without chill in a metal mold. For further information, send for booklet.

Bell end view of Super-de Lavaud machine in action

# U.S. SUPER-de LAVAUD PIPE

**CAST WITHOUT CHILL IN A METAL MOLD**

UNITED STATES PIPE AND FOUNDRY CO., General Office: BURLINGTON, N. J.

Foundries and Sales Offices throughout the United States

# WATER WORKS & SEWERAGE

L. H. ENSLOW,
Editor

## LEADING ARTICLES To Appear in the Next and Subsequent Issues

"Developments in Sewerage and Sewage Treatment During 1934" will be reviewed by Langdon Pearse, Sanitary Engineer, of Chicago Sanitary District.

G. Gale Dixon, Cons. Eng., Youngstown, Ohio will discuss the "Hyrdaulics of Rapid Filters" from the standpoint of the designer and water-works manager who seeks to procure genuinely effective filter washing under all conditions and at the least construction cost and operating expense. The author's experience make possible the presentation of facts and comments of especially practical value.

"The Performance and Efficiency of the Chicago Aerator" is to be reported on by Professor L. H. Kessler of the University of Wisconsin. The results of a study made by himself and P. F. Morgan, at the Monroe, Wisc., Sewage Treatment Works, of the new Chicago Combination Aerator and Clarifier Unit are to be set forth.

"Public Utilities as Political Door-Mats" is the title of an interesting d'scussion by Francis W. Collins who writes from the point of view of the utility engineer and the operator—both of which he has been.

H. H. Hendon, in the Dec. 1933 issue of WATER WORKS AND SEWERAGE, described the design of a projected sewage treatment plant under construct'on at Birmingham, Ala., to employ chemical precipitation. He will shortly disclose results attained at this plant during 6 months of operation and cite cost data and conclusions reached.

"Practices in Water Meter Replacements" as developed and applied in Los Angeles are to be disclosed by Chas. L. Ruckman, Asst. Supt., of Meter and Service Div., of the Los Angeles Water Department.

"Sewage Sludge, Its Preparation and Sale" constitutes a story, relating four years of experience in marketing digested sludge as fertilizer at Dayton, Ohio by M. W. Tatlock, Supt. of Dayton's Treatment Works. Purchasing sludge from nearby plants to make up local deficiency in order to meet demands for sludge fertilizer is something new in sludge disposal experiences.

Chas. H. Capen, Jr., Consulting Engineer, West Orange, N. J., will write on "Water Works Financing—Past, Present and Future"—in which privately and publicly owned systems are compared.

"Water Softening and Treatment Practices of the A. C. L. Railroad will be reviewed by O. L. Anderson, Supervisor of Water Treatment, on this important railway system.

S. R. Spencer, Chairman of the Water Commission, tells how satisfactorily the Commission Form of Water Department Control has functioned at Waco, Texas during its operation over the past 30 years without political intrusion. This story will be music to the ears of many, many Municipal Water Works Managers and employees.

Vol. LXXXII, No. 1

## CONTENTS for JANUARY, 1935

Illustration on Cover: The Spillway of Baltimore's New Prettyboy Dam
Photo by GEO. C. DOBLER
Baltimore Water Department

Water Supply and Purification Developments During 1934 ..... 1
By I. W. MENDELSOHN

Experiences in Freezing and Thawing of Water Mains and Services .. 8

Meadville Sewage Treatment ..... 9
By C. H. YOUNG
District Engineer, Pennsylvania Department of Health, Meadville, Pa.

Practical Aspects of Storing and Handling Ferric Chloride ..... 12
By J. M. POTTER
Chemical Engineer, Technical Service Department
Pennsylvania Salt Manufacturing Co., Philadelphia, Pa.

Comparative Notes on Field Joints for Large Diameter Steel Pipe .. 16
By W. C. CURD
Consulting Engineer, Cincinnati, O.

A Study of Filtering Materials for Rapid Sand Filters ..... 20
By JOHN R. BAYLIS
Physical Chemist, Department of Public Works, Chicago

Meeting of New York State Section A. W. W. A. ..... 26

Benefits Resulting from Plant Beautification ..... 27
By EDWARD H. RUEHL
Water Works Engineer, Roanoke, Va.

Editorial ..... 31

New Equipment and Literature ..... 32

**Published monthly by the GILLETTE PUBLISHING CO., Daily News Building, Chicago, Ill.**

Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879. Published monthly at 400 W. Madison Street, Chicago, Ill. Per copy 25c. Subscription rates $2.00 per year. Canadian and Foreign, $3.00 per year. Copyright, 1935, by Gillette Publishing Company. Publishers of: Water Works and Sewerage, Roads and Streets, Oil and Soap, The Art of Mosaics and Terrazzo, Road and Street Catalog and Data Book, Water Works Catalog and Data Book.

HALBERT P. GILLETTE, Pres. and Editor in Chief; E. S. GILLETTE, Vice-Pres. and Secretary; E. C. KELLY, Vice-President; J. M. ANGELL, JR., Eastern Manager; L. H. ENSLOW, 420 Lexington Ave., New York, N. Y., Editor; C. T. MURRAY, Managing Editor; JOHN R. BAYLIS, Associate Editor; D. G. LEDGERWOOD, Make-Up Editor.

Chicago Office, Daily News Building. Lakewood, Ohio Office, 1514 Cohasett Ave. New York Office, 420 Lexington Avenue. San Francisco Office, 155 Montgomery Street.

Addresses will be changed as frequently as desired, upon notification; not otherwise. Changes of address should be sent in at least two weeks before the date of the next issue of *Water Works and Sewerage*, in order for them to be effective for that number. Immediate notice should be given of any delay in the receipt of the magazine.

# On SLUDGE DEWATERING

• • • • •

## You Cannot *As Yet* Dispense with Experience

The continuous, mechanical dewatering of sewage sludges is now accepted as both practical and economical. Most sludges are amenable to this method of dewatering; also combinations of domestic sewage sludges and trade wastes.

But the time is not yet here when you can risk dispensing with that one basic necessity —*experience*. It is still needed to assure the proper installation.

The experience of our Sanitary Department in mechanical dewatering of sludges began twelve years ago when the first successful continuous dewaterers were installed. They were Olivers. Today, there are 51 of these units with a total filter area of about 22,000 sq. ft. either operating or being installed.

All this points to *real experience*. Call upon it in the study of your sludge dewatering problem.

**Advantages of Continuous Mechanical Dewatering**

elimination of all the nuisance factors such as flies, odors, unsightly areas

compactness and ease of operation

low installation and operating costs

unaffected by weather conditions.

OLIVER UNITED FILTERS INC.

New York 33 West 42nd St.

Chicago 221 N. La Salle St.

San Francisco 351 California St.

When writing to advertisers please mention WATER WORKS AND SEWERAGE—Thank you.

# THE NEW ALOXITE BRAND

REG. U. S. PAT. OFF.

## "RSF"* POROUS UNDERDRAIN PLATES

**Rapid Sand Filter*

THE most outstanding improvement in filter design in recent years. The underdrain system using Aloxite Brand "R S F" plates offers these advantages:

Absolute uniformity of backwash.

Positive and permanent protection against disruption of the sand bed.

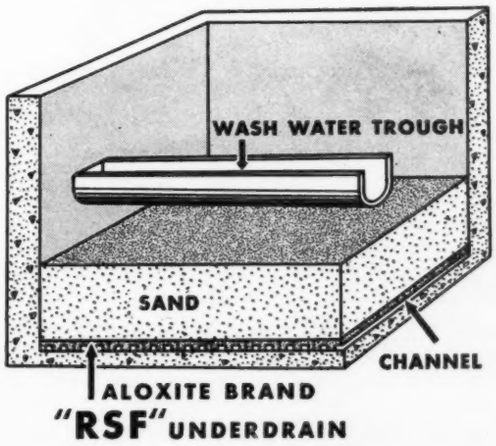
Lowered construction cost—elimination of gravel layers.

Plates bonded directly to filter floor—no ridges or holding down bolts.

Reduced operating heads, both filtering and backwashing.

Permits air wash without auxiliary equipment.

*Write our Sanitary and Filtration Department for further details and literature.*




## THE CARBORUNDUM COMPANY

REG. U. S. PAT. OFF.

NIAGARA FALLS, N. Y. CANADIAN CARBORUNDUM CO., LTD., NIAGARA FALLS, ONT.

(Carborundum and Aloxite are registered trade-marks of The Carborundum Company)

Please mention WATER WORKS AND SEWERAGE—it helps.

# A POSITIVE ODOR DETECTOR

*Furnished to You*
**FREE!**

THE illustration shows a very simple, tho positive odor detector, developed by F. E. Stuart of our Water Purification Division, to enable water works men to determine with assurance whether their water supplies are actually odor free.

Two tubes are used to conduct the odors to the nose—each functioning separately. The capacity of each tube is just sufficient for normal breathing, because smaller tubes would restrict respiration and the ability to detect traces of odor.

Thru the use of this simple apparatus, which is equivalent to extending the nostrils into the flask, very slight odors can be detected—the warmer the water, the easier the odors will be detected.

Complete instructions on how to use the device are included with the detector which will be sent you FREE and Postpaid immediately upon request. Sign the coupon today.

Industrial Chemical Sales Co., Inc.,
230 Park Ave., New York

Send along the Nuchar Odor Detector. No charge and no obligation. Address it to

Name .....

Position .....

Company .....

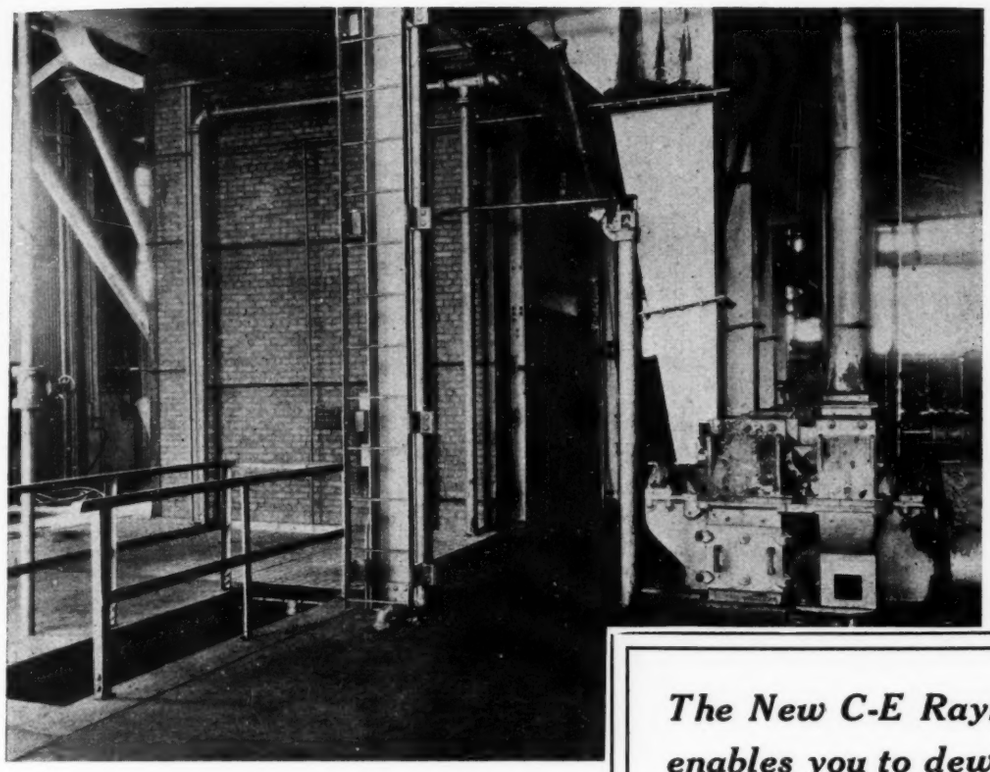
Address .....

## INDUSTRIAL CHEMICAL SALES COMPANY, INC.

230 PARK AVENUE, NEW YORK — NUCHAR — 205 W. WACKER DR., CHICAGO

Yes—we would like you to mention WATER WORKS AND SEWERAGE.

# Now you can dispose of Sewage Finally and Economically



*View of furnace and sludge drying equipment in the West Side Sewage Treatment Works of the Sanitary District of Chicago.*

***The New C-E Raymond System enables you to dewater, dry and burn Sewage Sludge at Low Cost and without Odor.***

In recent years energetic attacks have been made on the problem of sewage disposal. All that have made substantial progress point to sewage sludge incineration as the logical method of disposing of the end product of sewage treatment.

The difficulty has been to develop a system of incineration that would assure complete combustion at a sufficiently low cost to be practicable, and with absolute assurance of odorless operation.

The C-E Raymond System, now successfully applied in a commercial unit at the West Side Sewage Treatment Works of the Sanitary District of Chicago, has completely demonstrated its ability to meet these requirements in actual everyday service. Fuel consumption has proven to be extremely low; drying and pulverizing, followed by combustion in suspension, has eliminated all furnace and firing difficulties; and a systematic survey of the surrounding territory with the plant in operation has shown that elimination of odor is complete.

We are prepared to furnish C-E Raymond System Units for conditioning and burning any type of sewage sludge; and to fully guarantee capacity, thermal efficiency and odorless operation. Write for BULLETIN—*"Incineration Ends the Sewage Problem."*

## COMBUSTION ENGINEERING CO., INC.

*200 Madison Avenue, New York, N. Y. . . . . Canadian Associates, Combustion Engineering Corporation, Ltd., Montreal*

MANUFACTURING DIVISIONS: The Hedges-Walsh-Weidner Company, Chattanooga, Tenn.; Coshocton Iron Company, Monongahela, Pa.; Raymond Brothers Impact Pulverizer Company, Chicago, Illinois; Heine Boiler Company, St. Louis, Mo.

# *Then*... EVEN BETTER THAN WAS EXPECTED

## *... and now even the remarkable results reported by Dearborn last July have been surpassed*

ENGINEERS considering modern methods of sewage disposal, with or without the complications added by industrial wastes, will do well to continue to observe the results achieved at Dearborn, Mich., by *modern* Chemical-Mechanical processes, followed by the Laughlin Magnetite Filter—in the West Side plant.

According to Mr. Mark B. Owen, Dearborn's Superintendent of Public Works, the results during the first two years have proven highly satisfactory to city officials. The quality of effluent has exceeded what was expected when the system was planned, and the cost of operation has come well within the amount estimated when the plant was ordered built.

Writing in SEWAGE WORKS JOURNAL, July, 1934, Mr. Owen stated that during six months of this operating period, one Laughlin Magnetite Clarifier treated 1.74 m.g.d of raw sewage alone. During this period an eighty-five day run under conditions more typical of other installations, gave an average b.o.d. in the effluent of 20 p.p.m.—*a reduction of* 85%.

These results were secured in a plant not designed to obtain such a high degree of treatment, and the performance strikingly emphasized the flexibility of the methods used.

*Interesting as was this report, further striking records are now in the making. Since then, new equipment—designed to more effectively use the small chemical dosage, or acting to secure higher degrees of treatment at present dosage—has been installed.*

Preliminary reports verify the sound engineering imagination of the designer.

Further information can be had by writing to

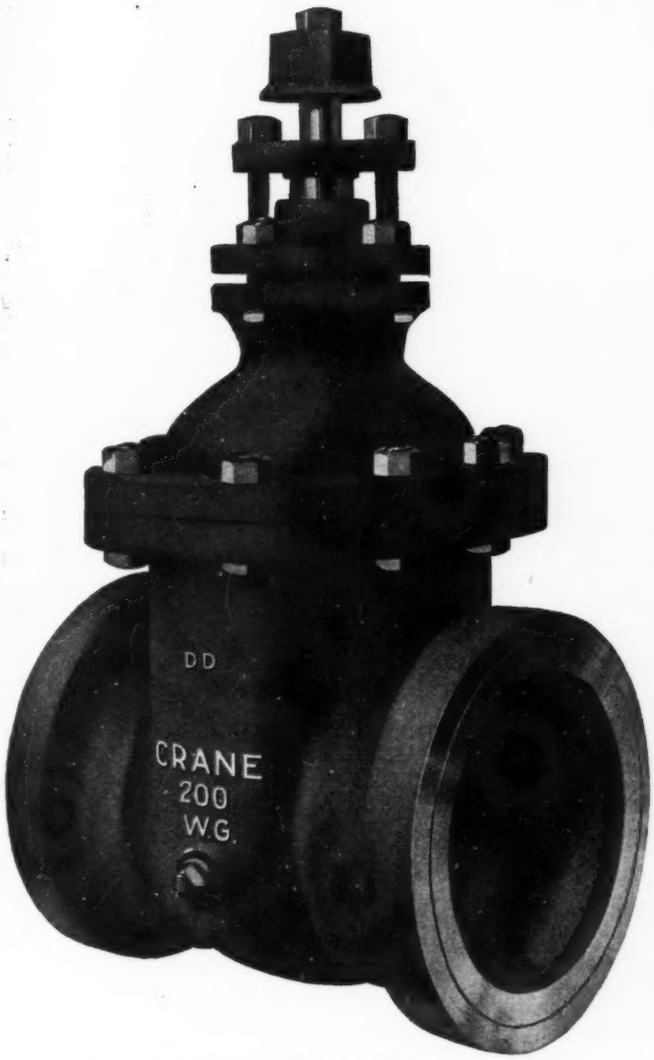
## FILTRATION EQUIPMENT CORPORATION

*Division of* AMERICAN CYANAMID COMPANY

Sales Office: 350 Madison Avenue New York

# A TRUE, TIGHT FIT

## FOR EVERY TYPE OF WATER WORK SERVICE




*Crane No. 480½ Double Disc Gate Valve with hub and connections. Can also be furnished with flanged ends.*

● This double disc gate valve is built ruggedly, carefully finished to operate smoothly, efficiently throughout a long and trouble-free life. It complies with AWWA specifications, and with many municipality specifications. Beyond AWWA requirements, there is the protection of the Crane name and Crane experience to assure a high standard of engineering quality in these Crane Double Disc Gate Valves. They are designed to function effectively under regular working conditions and under the pressures recommended. The construction of this valve prevents any stripping of threads on the stem through disc being out of line, or of springing the stems to either side while closing the valve. This AWWA double disc gate valve can be furnished with Indicator, Hydraulic Lift Cylinder, Spur or Bevel Gearing, or with Air or Electric Motor Control. Valve sizes range from 2″ to 48″.

NRA MEMBER U.S. WE DO OUR PART

# CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO, ILLINOIS • NEW YORK: 23 W. 44TH STREET

*Branches and Sales Offices in One Hundred and Sixty Cities*

# NEWS FLASH!

Columbus, Ohio.

Boyajohn & Barr, Inc., holders of sewage plant Contraet No. 4 have placed their order for 4—36" Venturi Meters with Builders Iron Foundry of Providence, R. I.

## Follow Columbus—

the "City" is as right in 1935 as the "Man" was in 1492!

Columbus lead in claiming the world was round and history proves he was right. Columbus, Ohio, became a leader in a program of Venturi sewage metering when they installed a Venturi in 1907. History proved they were right, too, and 1921 and 1928 found them installing more meters. In 1934 40 more Venturis were ordered on Contract No. 1 for the big new sewage plant now building.

There were no meters on Contracts No. 2 and No. 3 but now Venturis have been ordered for Contract No. 4!

Why? Because the efficiency of this new plant will depend absolutely on the reliability of the information furnished by these Meters. With year-in and year-out efficiency hinging on the selection of metering equipment Venturi Meters were the obvious choice.

When you face similar problems you will do well to "follow Columbus" and specify "Builders Iron Foundry."

FOLLOW THE BUILDERS CAMERMAN

*as month by month he shows views and news of interesting installations.*

**BUILDERS IRON FOUNDRY** 9 CODDING STREET PROVIDENCE • R • I •

*Bulletin 260—Venturi Meters for Main Pipe Lines.*
*Bulletin 232—Venturi Direct Acting Controllers.*

*Bulletin 273—Chronoflo Telemetering System, transmitting flow, pressure, or level measurements for "hundreds of feet or hundreds of miles."*

# "Scru-Peller" Sludge Pump

Screw-Feed Centrifugal

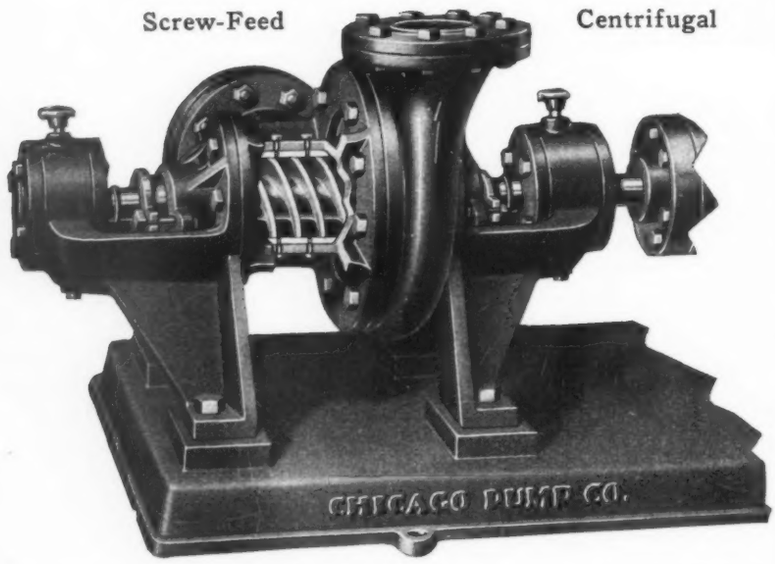



Fig. 1860—Chicago "Scru-Peller" Sludge Pump which was developed especially for handling Primary Sludge. The casing has been cut away in this picture to show the screw conveyor in the suction ahead of the impeller. The capacity can be varied from maximum of the pump all the way down to 1 G.P.M.

## It Cuts As It Pumps Primary Sludge

Stellited cutting edges in the pump casing on both sides of the impeller cut up solids and prevent binding of the pump.

We have found that these stellited cutting edges are absolutely essential for successful operation of a centrifugal pump in handling Primary Sludge.

## CHICAGO PUMP CO.

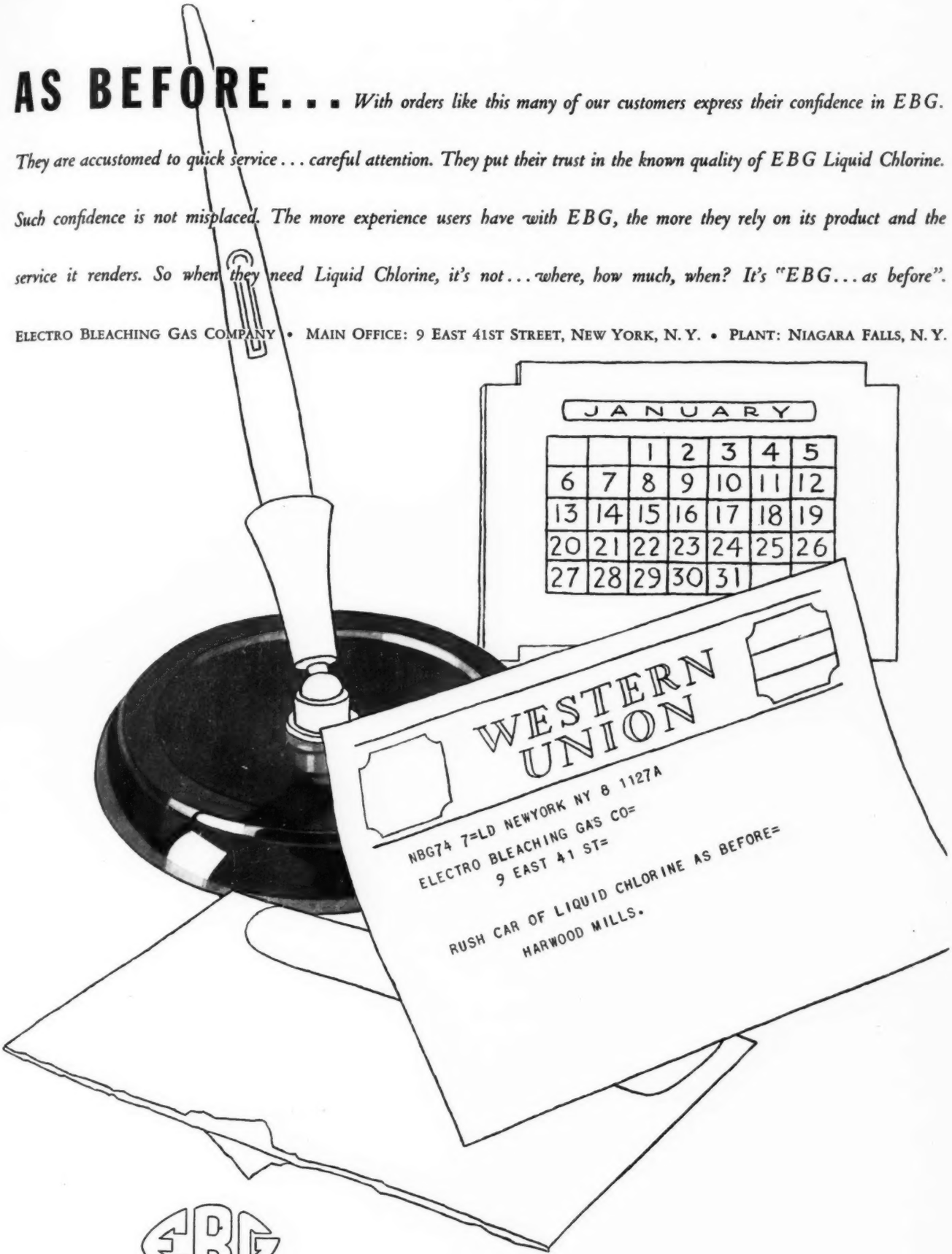
SEWAGE—BILGE—FIRE—HOUSE—CIRCULATING—CONDENSATION—VACUUM

2349 Wolfram St., CHICAGO, ILL. Phone Brunswick 4110

# AS BEFORE . . .

*With orders like this many of our customers express their confidence in EBG. They are accustomed to quick service . . . careful attention. They put their trust in the known quality of EBG Liquid Chlorine. Such confidence is not misplaced. The more experience users have with EBG, the more they rely on its product and the service it renders. So when they need Liquid Chlorine, it's not . . . where, how much, when? It's "EBG . . . as before".*

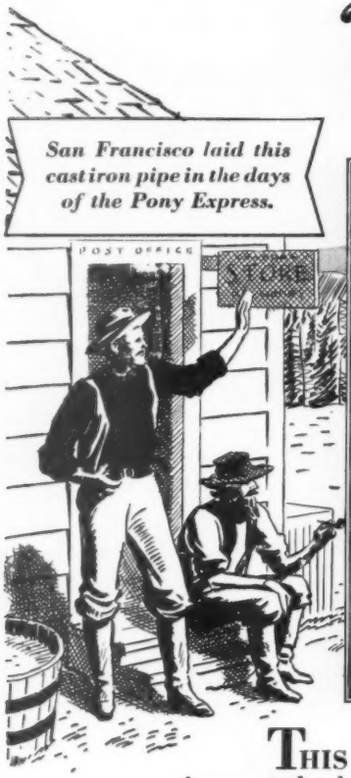
ELECTRO BLEACHING GAS COMPANY • MAIN OFFICE: 9 EAST 41ST STREET, NEW YORK, N. Y. • PLANT: NIAGARA FALLS, N. Y.


JANUARY
1 2 3 4 5
6 7 8 9 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
27 28 29 30 31
WESTERN UNION
NBG74 7=LD NEWYORK NY 8 1127A
ELECTRO BLEACHING GAS CO=
9 EAST 41 ST=
RUSH CAR OF LIQUID CHLORINE AS BEFORE=
HARWOOD MILLS.

EBG Liquid Chlorine

FIRST IN THE COUNTRY

# New 75 Years Ago "Good as new" Today




*San Francisco laid this cast iron pipe in the days of the Pony Express.*

THIS unretouched photograph shows at the bottom of the trench an 8-inch cast iron water main installed in San Francisco in 1859 and still in service. When this old pipe was uncovered in January 1932 for the inspection of Mayor Rossi and other city officials, it had been in continuous service for 73 years and was in excellent condition. It is a section of the *first* cast iron water main laid in San Francisco.

In older cities of Europe and the United States, cast iron mains still in use, after serving 100 to 200 years and longer, were recently uncovered and inspected. All were in satisfactory condition for further service. Thus, evidence accumulates to prove that the useful life of cast iron pipe is *more than a century.*

The reason for the long life and low maintenance cost of cast iron pipe is its effective resistance to rust. Cast iron is the one ferrous metal for water and gas mains, and for sewer construction, that will not disintegrate from rust. This characteristic makes cast iron pipe the most practicable for underground mains since rust will not destroy it.

## *The* 4 *Economies of* Cast Iron Pipe

1. Official records of cast iron pipe laid 100 to 200 years ago and still in service, prove that it is *cheapest in the end.*

2. Official reports on file in the office of a prominent technical publication, prove that cast iron pipe is *cheapest to maintain.*

3. Long-lived pipe obviously causes less street-opening for replacements and repairs. Therefore, cast iron pipe *saves money on street-openings.*

4. When replaced by larger pipe, or a main is abandoned or rerouted, cast iron pipe *pays a final dividend in salvage value.*

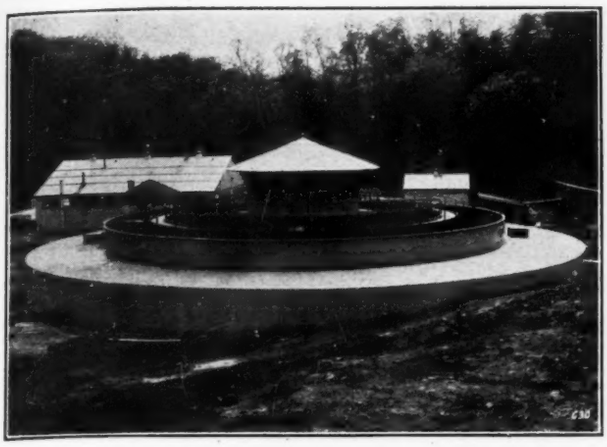
For further information, address The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 309 Peoples Gas Building, Chicago, Ill.

*Methods of evaluating bids now in use by engineers rate the useful life of cast iron pipe at 100 years*

# CAST IRON PIPE

*Look for this* *trade-mark*

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. LXXXII JANUARY, 1935 NO. 1



*The "Stream Lined" Filtration Plant of 1934. The Most Unique Plant in America (5 MGD Capacity) Went Into Service at Burnt Mills, Md., in May, 1934. It was Designed by Robert Morse, Chief Engineer, Washington Suburban Sanitary District, and His Staff. A Central Pipe Well Is Surrounded by the Filters, Then the Coagulating Basin and the Outside Ring Form the Clear Water Storage. All of Steel Construction*

# WATER SUPPLY AND PURIFICATION DEVELOPMENTS DURING 1934

By I. W. MENDELSOHN, C. E.
*New York City*

A REVIEW of world achievements in water supply and purification in 1934 discloses several outstanding developments in the economic and structural aspects and emphasizes certain significant trends in purification practice. The year was singularly free from any large waterborne disease outbreak.

By far the most striking feature is the impetus furnished by the government to water works installations and improvements in the United States. When the Emergency Relief and Construction Act (RFC) was passed in 1932 to extend federal aid to general construction for states, municipalities and even private corporations—an unprecedented event in American history—waterworks were prominently mentioned as one of the few types of self-liquidating projects eligible for RFC loans. With the passage of the National Industrial Recovery Act in 1933 and the subsequent establishment of the Federal Emergency Administration of Public Works (PWA) the immediate response lifted the volume of water works contracts let from the low of 35 million dollars in 1932 to 67 million dollars in 1933 as shown in Table I.

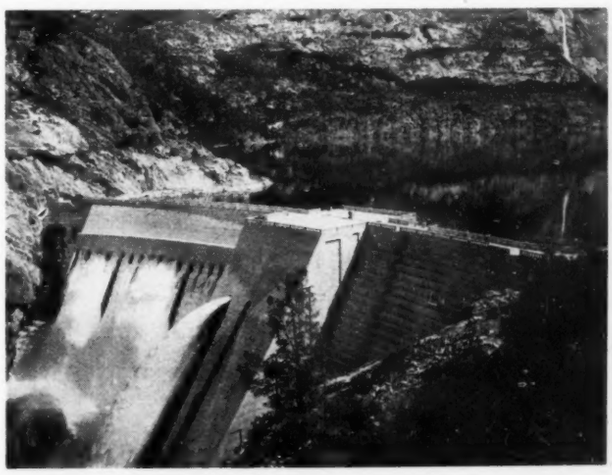
TABLE I—ENGINEERING CONSTRUCTION CONTRACTS FOR 1928-1934, GIVING COMPARISONS BETWEEN WATER WORKS AND TOTAL CONTRACTS

| Year | Total | Federal, per cent | Water works, per cent | Amount |
|---|---|---|---|---|
| 1928..... | $3,551,000,000 | 2.0 | 2.8 | $99,000,000 |
| 1929*..... | 3,950,000,000 | 2 6 | 1.2 | 49,000,000 |
| 1930..... | 3,173 000,000 | 3.7 | 1.5 | 49,000,000 |
| 1931..... | 2,454,000,000 | 11.4 | 2.3 | 56,000,000 |
| 1932..... | 1,219,000,000 | 22.3 | 2.8 | 35,000,000 |
| 1933..... | 1,068,000,000 | 20.3 | 6.3 | 67,000,000 |
| 1934**..... | 1,177,000,000 | 22.4 | 6 6 | 78,000,000 |

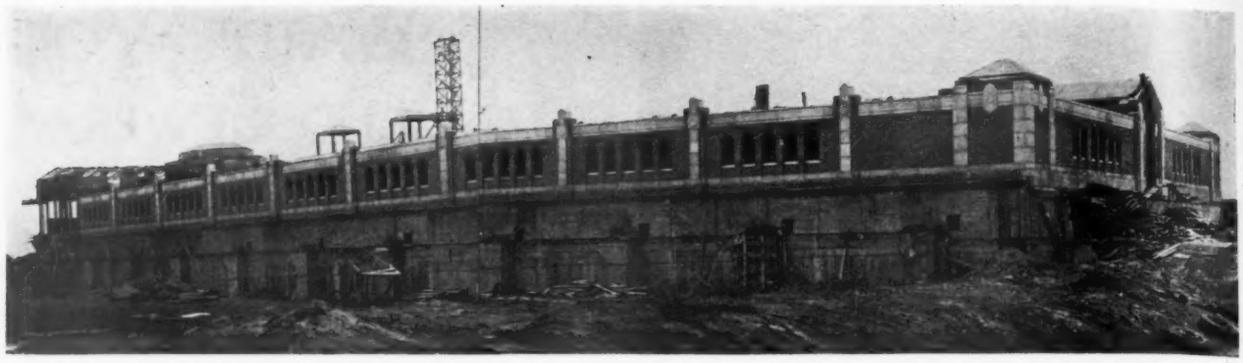
*Year of maximum construction contracts let.
**Figures for 11 months.

The volume in 1933 is greater even than in 1929, the year of maximum construction contracts, despite the 73 per cent reduction in total construction contracts let in 1933. In 1934 (11 months) the volume of water works construction contracts was 12 per cent larger than in all of 1933. But for this timely federal aid, water works construction in 1933-1934 would readily have fallen to an all-time low. The outlook for 1935 is for increased volume of water works construction in step with increased general construction throughout the nation and the Administration's policy to continue, if not expand, its program of public works construction.

Prior to the inception of the PWA, the era of "rugged-individualism" had developed unsound economic practices in the water works industry as elsewhere in the country. In its first year of operation the PWA through strict and impartially administered requirements has influenced all basic water works factors and is laying the groundwork for a healthy future growth.



*San Francisco's O'Shaughnessy Dam, Impounding a 3½ Year Supply 155 Miles from the City, Went Into Service as the Largest Water Supply Project Completed in 1934*



*The Victoria Park Filtration Plant Now Under Construction Is a Part of Toronto's* $14,000,000 *New Water Supply Project*

Table II, which presents comparisons between water works and total allotments, by PWA, reveals that in the first 18 months out of 2.5 billion dollars in appropriations, allotments have been made for 1,044 water works projects involving more than 94 million dollars of which 98 per cent was for non-Federal works. It is significant to find that of the 4,053 non-Federal projects, 23 per cent (953) are water works, 694 being complete water works systems. Extensive improvement in small water works which are revealed by these allotments has been a very worthwhile feature. Much still remains to be done to approach such state estimates as that of New York State Department of Health Officials in 1933, that 38 million dollars were needed for 86 water works projects in the state outside of New York City, or the estimate of the American Water Works Association that $500,000,000 would be required for the immediate water works needs of the country for 1934-1935.

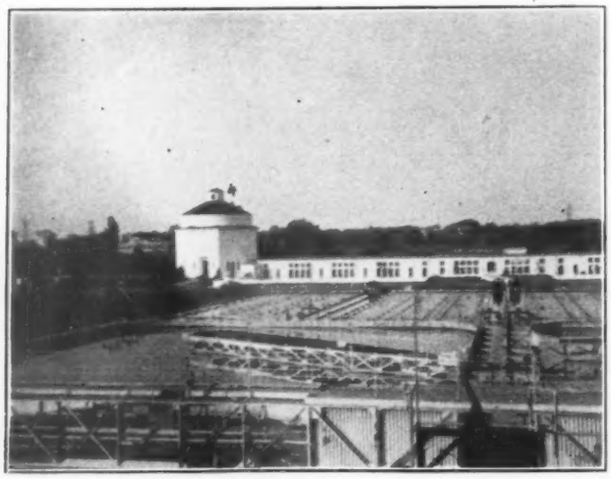
TABLE II—CONTRUCTION PROJECT* ALLOTMENTS OF PUBLIC WORKS ADMINISTRATION, JUNE, 1933-NOVEMBER 1, 1934, GIVING COMPARISONS BETWEEN WATER WORKS AND TOTAL ALLOTMENTS (COMPILED FROM PUBLIC WORKS ADMINISTRATION DATA)

| | Non-Federal Projects | | Federal Projects | | Total Projects | |
|---|---|---|---|---|---|---|
| | | Allotment | | Allotment | | Allotment |
| Class | No. | ($000,000) | No. | ($000,000) | No. | ($000,000) |
| Total all types**. | 4,053 | 999 | 5,874 | 1,532 | 9,927 | 2,531 |
| Water systems**. | 953 | 92 | 91 | 1.6 | 1,044 | 94 |
| Water mains... | 131 | 11 | 26 | .03 | 157 | ***11 |
| Filtration plants | 39 | 7 | 2 | .3 | 41 | 7 |
| Reservoirs ..... | 89 | 9 | 9 | .1 | 98 | 10 |
| Complete water works ..... | 694 | 65 | 54 | .9 | 748 | 66 |
| Sewer & water** | 60 | 6 | 17 | .3 | 77 | 6 |

*Contracts for many of these allotments were still not let on November 1, 1934.

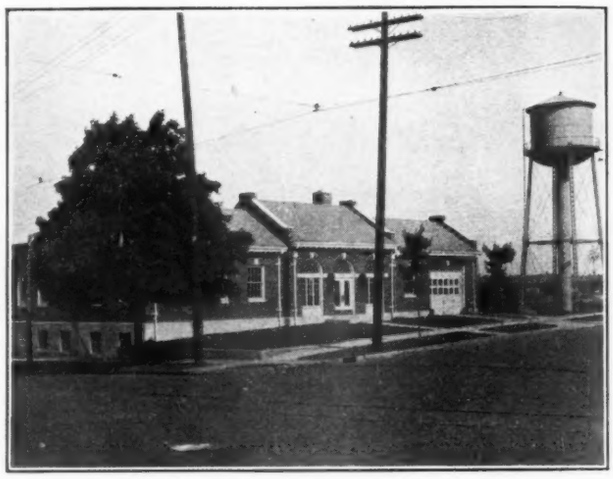
**Several allotments involve only 30 per cent of project cost.

***The sum being less than 11.51, 11 is used.



*Extensions to Sacramento, Calif., Filtration Plant. Primary Clarifiers and Surface Settlers in Foreground Are Recent Additions. Filters, Beyond, Were Extended*

The year 1934 was auspicious for the completion of three important projects. The Hetch Hetchy Aqueduct, 155.2 miles long, was begun 20 years ago to bring 400 m.g.d. of water to San Francisco at a cost of $100,000,000, and the Swift River development of reservoir and connecting tunnel with the Wachuset Reservoir augments the Boston supply. Pasadena's new Morris Dam was

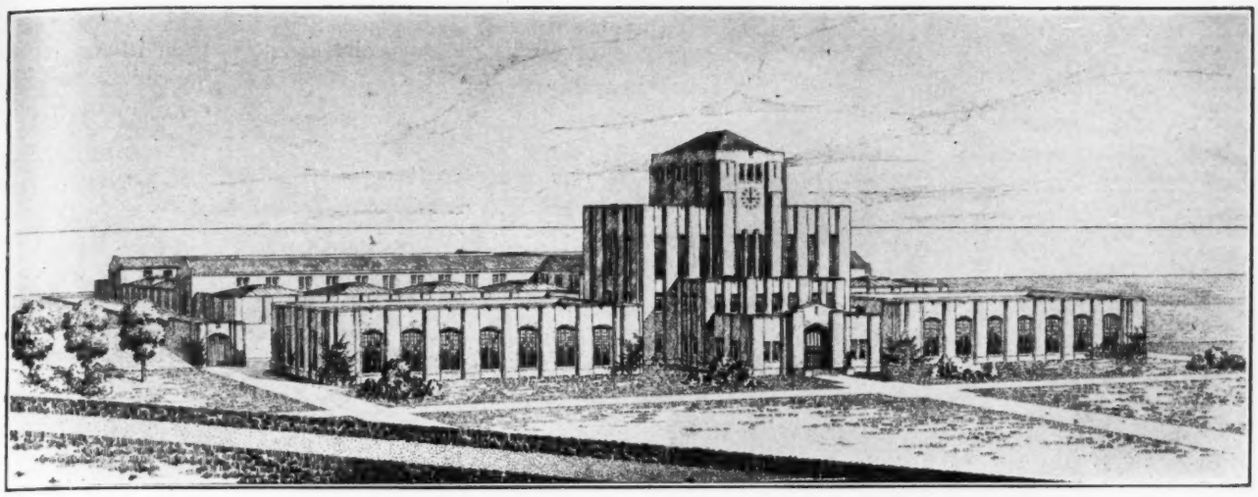


*Water Softening Plant of Lancaster, O. Newest of Zeolite Softening Plants Serving Municipalities*

dedicated by ex-president Hoover and placed in service. Other water works improvements completed in 1934 are noted in Table III. Ten additional projects are listed as construction begun while 26 others are definitely assured of early construction. It is to be noted that construction of the much talked of and long delayed filtration plant for Milwaukee's water supply was at last begun in 1934 after prolonged and at times bitter opposition. The volume of water works construction in the United States in 1934 because of federal stimulus was larger than in any other country in the world.

## National Resources Board Established

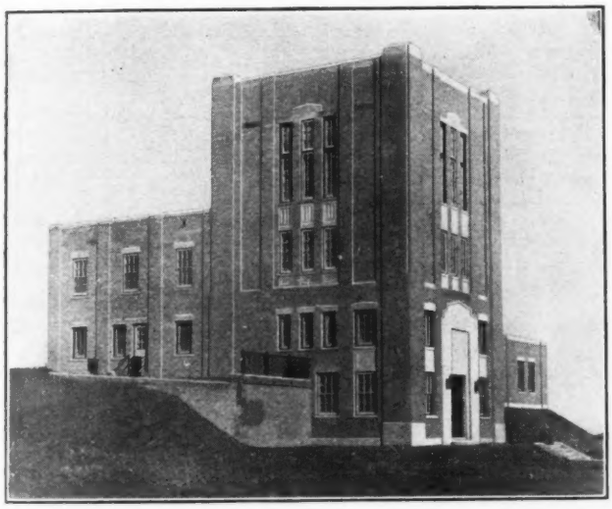
The second outstanding feature was the establishment of the National Resources Board, successor to the National Planning Board organized by the PWA in 1933, to make comprehensive investigations of land uses and water resources. The general purpose of this organization is to provide a basis for drafting national policies regarding the development, use and protection of these two prime resources. The Water Resources Section of this board has prepared a report on inventory of the na-



*Artist's Conception of Milwaukee's 200 MGD Filtration Plant Which Was Put Under Construction in 1934 as a P. W. A. Project (Alvord, Burdick & Howson, Engineers)*

tional water resources and a plan and policy for their more orderly development in the future. In this manner the PWA is not only stimulating the volume of water works construction, but is also providing for a long term plan of development—the first time such a program has been launched in the nation's history.

A development policy of this nature and scope has long been needed and is particularly timely in view of the 1934 drought. According to the Weather Bureau, "At the end of May, 1934, the most extensive drought in the climatological history of the United States had developed in the interior, and in the northwestern and western states." Public water supplies in North and South Dakota, Nebraska, Kansas, Missouri, Iowa, Mississippi and Utah were affected. The drought has markedly emphasized the necessity of adequate feeder mains and the value of elevated storage.

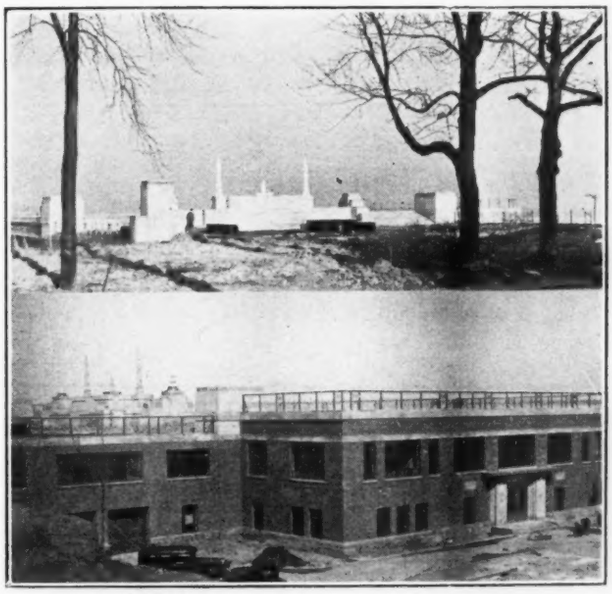


*The New 4 MGD Water Softening and Filtration Plant at Aberdeen S. Dak.*

## Water Treatment

A great deal of attention was directed by water works operators in the United States in 1934 toward improving the quality of water—to make it more pleasing to the taste and suitable for industrial use. There was a marked tendency for improved treatment preliminary to filtration. Chlorinated copperas and ferric sulphate were used successfully at two important plants as coagulants. At Dallas, Tex., chlorinated-copperas has proven efficient and economical. At Providence, R. I., ferric sulphate has been adopted; at Oklahoma City ferrous chloride, generated from scrap iron and chlorine.

Prechlorination with the addition of activated carbon to the raw or applied water was found to be the most effective practice in odor and taste control. The extended use of activated carbon has been marked—Baltimore, Md., being the largest city to adopt it in 1934. The application of chlorine, especially in small water supplies, was improved. The use of the ammonia-chlorine process was further clarified, its effectiveness being especially high in prolonged sterilization, in eliminating tastes created by stagnation of water in dead ends, and in preventing tastes due to checking corrosion, and tuberculation, past chlorine application. Softening of water progressed with numerous mechanical improvements in lime-soda treatment and recarbonation of softened water to prevent after precipitation. Partial zeolite softening of municipal supplies and automatic zeolitic softening received more attention. One plant, under construction, will remove iron by zeolite filtration.



*Wilmette's (Ill.) New Filter Plant on the Lake. Above: The Approach to the Plant—an Illuminated Fountain. Below: South Front of Plant Showing Fountain on Left, the Roof Serving as a Promenade Deck with Bathing Beaches Below*

*Boston's Swift and Ware River Water Supply Extension. Above: Ware River Intake Works. Here the Water Drops Vertically Through a Shaft with Spiral Break Fins Into the Quobbin Aqueduct Tunnel 260 Ft. Below. Below: The Quobbin Tunnel Is 24.61 Miles Long (a Few Feet Less Than The Hetch Hetchy Tunnel); Is 11 Ft. Wide by 12 Ft. 9 In. High*

## Improving Status of Water Works Operators

Of fundamental interest is the progress in improving the status of the water works' operators in the United States. State health departments, water works' associations and educational institutions during the year have been furthering water works operators' short schools, generally in connection with association meetings—more than eight such courses having been given. Virginia has gone so far as to establish regional schools to make attendance easy and inexpensive.

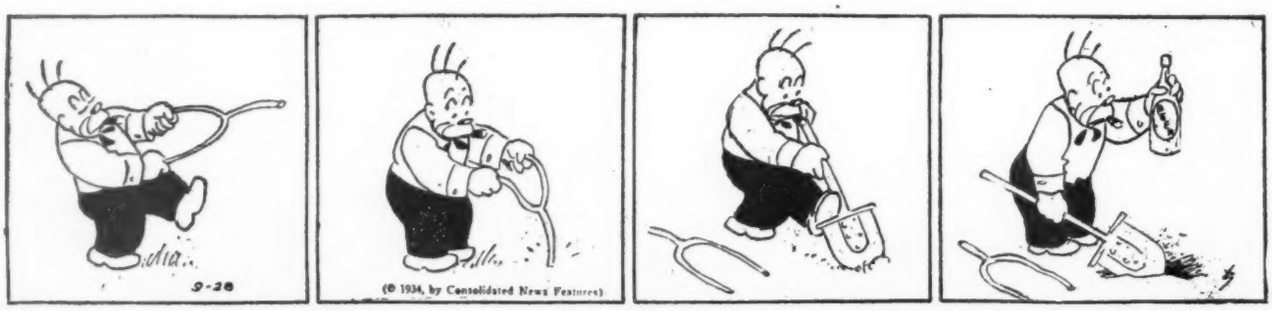
The adoption by states of water works operators' licensing laws is gaining momentum. West Virginia, Michigan and New Jersey already have such laws. Maryland is planning for one, and Wisconsin, Texas, Ohio, Pennsylvania and others are investigating the advisability of a licensing law. The benefits to the public by insuring competent water works operators through a licensing law are self evident. At the same time the status of the operators is enhanced. H. E. Jordan, as President of the American Water Works Association, has stressed his intention to work for an improved status for water works operators. This is one of the greatest

TABLE III—PARTIAL LIST OF NEW WATER WORKS PROJECTS*—COSTING $250,000 OR MORE—IN THE UNITED STATES IN 1934

| City | Project | Cost ($000,000) | Construction Status |
|---|---|---|---|
| Aurora, Ill. | Reservoir and mains | .45 | Pending** |
| Bayonne, N. J. | Mains | .6 | Pending |
| Blacksburg, Va. | Softening plant and storage | 1.1 | Begun |
| Boston, Mass. | Reservoir on Swift River and tunnel to Wachuset Reservoir (not PWA) | 50.0 | Completed |
| Boston, Mass. | Mains | .35 | Begun |
| Burnt Mills, Md. | Filtration plant, pumping stations (not PWA) | .35 | Completed |
| Coeur D'Alene, Ida. | Supply and system | .65 | Pending |
| Conneaut, O. | System and filtration plant (RFC) | .... | Completed |
| Denver, Colo. | Moffet Tunnel Water System additions | 3.5 | Pending |
| Detroit, Mich. | Extensions | .75 | Pending |
| East Jefferson, La. | System | .39 | Pending |
| Elyria, O. | System | .41 | Pending |
| Eureka, Cal. | Reservoir and supply line | 1.2 | Pending |
| Excelsior Springs, Mo. | System | .65 | Pending |
| Fort Smith, Ark. | Dam, reservoir, filtration plant, mains | 1.6 | Pending |
| Gloversville, N. Y. | Dam, mains | .26 | Begun |
| Houston, Tex. | Wells, reservoirs, mains | 2.5 | Pending |
| Joliet, Ill. | Dam, reservoir, filtration plant, mains | 1.8 | Pending |
| Los Angeles, Cal. | Bouquet Canyon reservoir and pipe line | 4.0 | Pending |
| Los Angeles, Cal. | Mono Basin Aqueduct and Tunnel (RFC) | 7.5 | Begun |
| Louisiana, Mo. | System, filtration plant, reservoir | .31 | Pending |
| Milwaukee, Wis. | Filtration plant | 4.6 | Begun |
| Nashville, Tenn. | Improvements | .3 | Pending |
| New Brunswick, N. J. | Filtration plant, pumping station, reservoir | .26 | Pending |
| New York City | Mains | .51 | Pending |
| New York City | Tunnel | 1.0 | Pending |
| Niagara Falls, N. Y. | Filtration plant | .45 | Begun |
| Ogden, Utah | Reservoir, mains, meters | .75 | Pending |
| Pasadena, Cal. | Morris Dam (not PWA) | 7.5 | Completed |
| Pecos, Tex. | System | .3 | Pending |
| Phoenix, Ariz. | Mains | .25 | Pending |
| Ponca City, Okla. | Dams, mains, filtration plant | .56 | Begun |
| Racine, Wis. | Improvements | .3 | Pending |
| Reading, Pa. | Reservoir, conduit, filtration plant | 1 2 | Begun |
| Rocky Mount, N. C. | Filtration plant, storage tank | .28 | Begun |
| Salem, Ore. | System | 2.5 | Pending |
| San Francisco, Cal. | Hetch Hetchy Aqueduct (not PWA) | 100.0 | Completed |
| San Francisco, Cal. | Mains, reservoirs, dam | 11.2 | Begun |
| Shawnee, Okla. | Dam, mains, pumping station | .75 | Pending |
| Tacoma, Wash. | Supply, reservoir | .32 | Pending |
| Wilmette, Ill. | Filtration plant (RFC) | .4 | Completed |
| Yonkers, N. Y. | Improvements | .3 | Pending |

*Financed through the Public Works Administration unless otherwise noted.

**Unless definite information showed construction actually begun, the construction status is listed as pending.

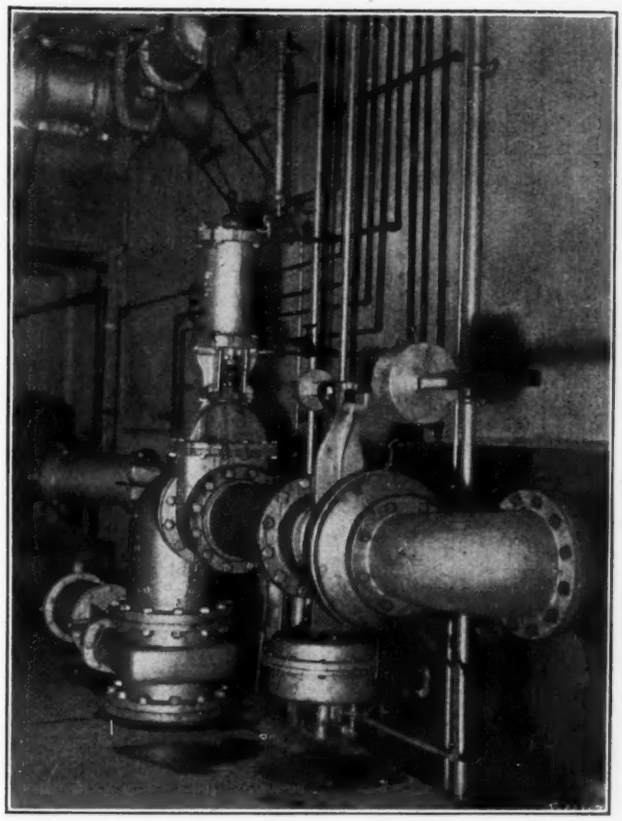



*Silent Sam—In Rome He Does as the Romans Do; in Weimer He Would a Water-Witching Go!—(Jacobson)*

efforts for the public good and advancement of water works men that the Association can rightfully perform.

Indicative of the increasing interest and self expression by operators is the large attendance at various sectional water works meetings held throughout the country during the year—the largest registration being that of the California Section of the A. W. W. A. with 850. In all, there has been great improvement in the relations between water works and the general public in 1934 due to appreciation by the industry of the desirability of such an approachment.

Other interesting features of the year in the United States include: (1) the development of the osmoscope by Fair and Wells to measure odors and tastes by the air dilution method; (2) development by Tonney and Noble of solid brilliant green lactose bile for making direct counts of the coli-aerogenes group of organisms; (3) pipe corrosion studies by Hale showing the great superiority of brass and copper pipe in resisting corrosion; (4) the introduction of porous plates for rapid sand filter bottoms; (5) studies of various materials including crushed anthracite coal for filters; (6) development (by Stover) of a new rate controller for filter plants; (7) construction of a new experimental water filtration plant at the Armour Institute of Technology; (8) the practicability and economy of cleaning and relining old water mains to recover their carrying capacities; (9) further progress in cross-connection elimination, and (10) the development of rational and equitable rate schedules for water supply improvements financed from revenue, due to the influence of the PWA.



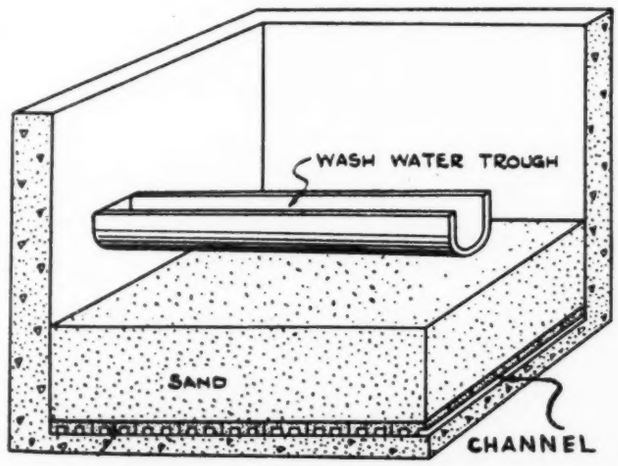
*Improved Rate Controller for Filters, Developed at the University of Pennsylvania*

## Foreign Developments

In other countries the volume of water works construction in 1934 seems to have declined appreciably from 1933. The number and size of installations completed or begun in the year is shown in Table V. From brief reports in the technical literature it is known that considerable water works construction was under way in Great Britain, India, Japan and Russia.

In Great Britain the drought, which began in the summer of 1933, continued well into 1934 and focused national attention on the necessity of providing for adequate water supplies. As one engineer so aptly stated, the water shortage has a most serious effect upon economic conditions. Farm lands become unproductive; cattle cannot be maintained at any reasonable cost; building estates are valueless; industries which would provide a support for the population become impossible; nurseries and market gardens suffer seriously; and the health conditions of the district are adversely affected. Apropos of this situation, a proposal for a national grid system whereby water districts in England would be connected by large overland mains was considered, but did not meet with the views of the Ministry of Health. The President of the British Water Works Association referring to the drought said, "Not a water grid, but a chain of regional water works to encompass the country" should be the present object of work. The drought conditions developed so that it was found desirable to hold a meeting of the Water Supplies Emergency Conference at the Ministry of Health to consider the situation.

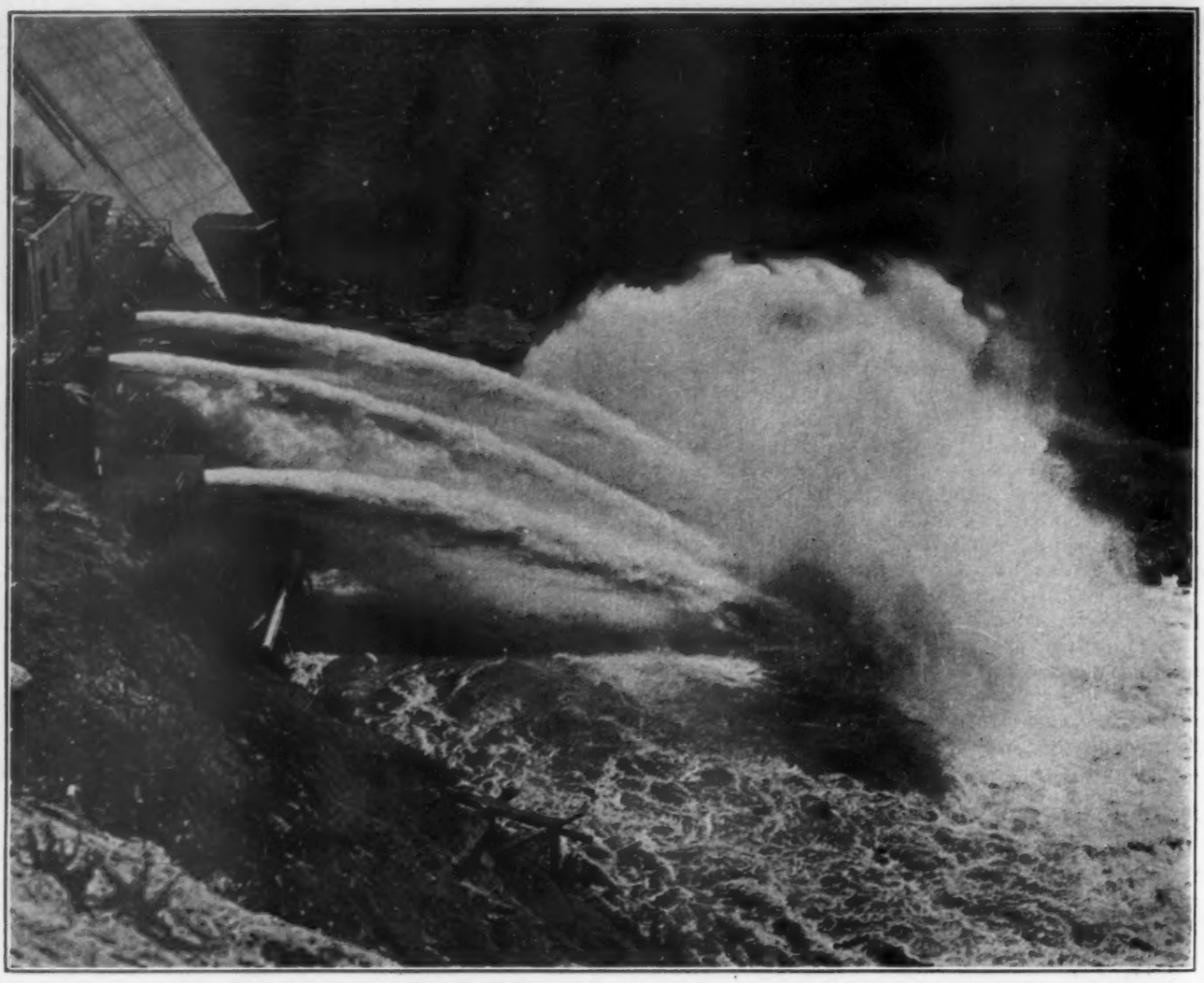
Because of the serious effect of the drought, especially upon rural sections, the Rural Water Supplies Act, 1934, was passed authorizing contributions by the Ministry of Health of $5,000,000 for England and Wales, and of $687,500 by the Department of Health of Scotland towards expenses incurred by local authorities in providing or improving rural water supplies. By mid-year grants




*New Development in Filter Bottoms. Porous Underdrain Plates Eliminate Gravel Bed, Manifold and Laterals*

TABLE IV—PARTIAL LIST OF NEW WATER WORKS PROJECTS COSTING $250,000 OR MORE—INSTALLED OR BEGUN IN FOREIGN COUNTRIES IN 1934

| City | Project | Cost Construction ($00,000) | Status |
|---|---|---|---|
| Cheltenham, Eng. | Reservoir, rapid sand filters, mains, pumping machinery | .25 | Completed |
| Eggborough, Eng. | Pumping station | .5 | Completed |
| Halifax, Eng. | Reservoirs | 3.5 | Completed |
| Oxford, Eng. | Pumping station, 3 reservoirs | 1.25 | Completed |
| Jerusalem, Palestine | Pumping stations and pipe line | 1.5 | Near completion |
| Pocklington, Eng. | New water system | .25 | Begun |
| Swindon, Eng. | Well, pipe line, reservoirs, pumps | .5 | Completed |



*Pasadena's New Morris Dam Blows Off a Little Steam. A Demonstration of Flood Water Release Through Four of the Six Automatic Needle Valves with Total Capacity of About 7,000 Cu. Ft./Sec. The Two Large 72 In. Valves Had Not Come Into Operation, the Discharge Being from Three 36 In. and One 42 In. Valves*

of $95,000 had been made to promote water works involving expenditures of $840,000. In addition the Ministry of Health during the fiscal year 1933-1934 sanctioned loans of $9,000,000 for water supply installations compared with $7,000,000 in 1932-1933, and direct sanction of loans to the value of $6,000,000 was made in the same period by Parliament in local acts under the Public Works Facilities Act of 1930, compared with $3,000,000 the previous year.

## National Water Boards Established Abroad

The drought in England was productive of advance planning. At the 1934 meeting of the Association of Urban Councils of England and Wales, a resolution was passed demanding formation of a National Water Board with full power to control the conservation and distribution of water supplies. This seems to be an extension of the recommendation of the Ministry of Health at the end of 1933 that Regional Advisory Commissions be formed to see that water resources were used to the best advantage by communities of like interest, as a result of which recommendation six commissions were functioning by the beginning of 1934—Southwest Lancashire embracing 22 authorities; West Riding of Yorkshire with 142 authorities; Sherwood Area of Nottinghamshire with 22 authorities; Isle of Wight with 8; Holland in Lincolnshire with 12; and South Buckinghamshire with 6. At the British Water Works Meeting in 1934, a resolution was considered affirming that, in the national interest, it was desirable and necessary that there should be a pooling of water resources and for a national board to be constituted with full powers to deal with the supply and distribution of water throughout England and Wales. At the end of 1934, the Ministry of Health influenced by the national trend, was contemplating a survey of the water resources of England and Wales. In this important respect Great Britain and the United States were instituting similar action for the first time in 1934.

It is interesting to note the increasing space assigned in English technical journals in 1934 to American water purification practice, and to the greater attention paid at British water works meetings to chlorination and rapid sand filtration practice in this country.

In this day of scientific enlightenment, it is of more than passing interest to note the persistence of human faith in the water diviner. The Society of British Dowsers early in 1934 offered to help the British Ministry of Health in the drought situation by locating springs and supplies of water throughout the country. As yet this offer has not been put to use. When recently the Cumberland Educational Committee at Whitehaven, England, considered a water supply development for a school, a resolution to empower the Building Committee to employ a water diviner was refused. One of the members aptly pointed out that England was spending

*Aqueduct and Reservoir of the Bouquet Canyon Project for Los Angeles Completed in* 1934. *Aqueduct Diameter,* 6 *Ft.* 8 *In. to* 7 *Ft.* 10 *In., to Stand Pressure Up to* 400 *Lb. Per Sq. In.; at Points Wall Thickness of* 1 1/16 *In. Employed*

thousands of pounds in developing the scientific side of water research, yet the committee was going back to the days of the witch doctor and necromancer in sending for a water diviner in place of the water scientist. Interestingly, the Germans in developing a new well supply for Weimar, at about the same time, accepted the divining rod procedure in locating the wells. It was stated that the forces which agitate the rod are caused by alterations in the electrical field in the air, which may be caused by water, hollow spaces or deposits of ore. The divining rod, according to the same statement, conducts the forces to the body of the diviner, causing muscular reactions. Greater faith evidently is still being placed in muscular reactions than in the geologists and water authorities available to some parts of the world.

For comparison with the membership of water works associations in the United States, it is of interest to note that the British Water Works Associations now include 252 water authorities—96 being municipal authorities—and 72 being water companies in England and Wales.

*The Work of the Water Diviner*

▼

## P.W.A. Encourages Private Financing

Cities, towns, counties and other local public bodies which have received combined loan and grant allotments from PWA for construction projects were assured recently by the Public Works Administrator that sale to private investors and bond dealers of their bonds, which PWA has contracted to buy, will not jeopardize the grant portion of their allotments. Administrator Ickes emphasized that the grant will be for the same amount.

With improving conditions in the municipal bond market many local bodies are receiving offers from investors and bond dealers for the securities PWA agreed to purchase when the bond market was stagnant. Inquiries received by PWA State Engineers in the field and by PWA headquarters in Washington show that many localities fear that private sale of their bonds would reduce the amount of their grants. Local public bodies receiving satisfactory offers for all or part of their bonds that PWA has contracted to buy should communicate immediately with the PWA engineers in their states and request permission to make the sales.

PWA welcomes the sale of the bonds it has contracted to buy to private investors and bond dealers, for such direct sales by local public bodies enables PWA to change the allotments from loans and grants to grants only and reallot the released money to additional projects to create more employment. Several hundred such changes already have been made, releasing more than $50,000,000 which has been re-allotted.

PWA now has on its books approximately 2,200 allotments of combined loans and grants to local public bodies. The grant portion of each allotment is for 30 per cent of the cost of labor and materials used on the job.

The following table shows the number of combined loan and grant allotments in each state as of December 1st, 1934:

| | | | | | |
|---|---|---|---|---|---|
| Alabama | 57 | Massachusetts | 12 | Rhode Island | 17 |
| Arizona | 22 | Michigan | 41 | South Carolina | 51 |
| Arkansas | 72 | Minnesota | 28 | South Dakota | 46 |
| California | 72 | Mississippi | 28 | Tennessee | 36 |
| Colorado | 19 | Missouri | 84 | Texas | 230 |
| Connecticut | 5 | Montana | 46 | Utah | 44 |
| Delaware | 3 | Nebraska | 23 | Vermont | 5 |
| Florida | 12 | Nevada | 12 | Virginia | 44 |
| Georgia | 39 | New Hampshire | 23 | Washington | 10 |
| Idaho | 21 | New Jersey | 67 | West Virginia | 36 |
| Illinois | 170 | New Mexico | 29 | Wisconsin | 27 |
| Indiana | 38 | New York | 202 | Wyoming | 5 |
| Iowa | 16 | North Carolina | 79 | Alaska | 6 |
| Kansas | 27 | North Dakota | 36 | Hawaii | 2 |
| Kentucky | 48 | Ohio | 123 | Puerto Rico | 4 |
| Louisiana | 40 | Oklahoma | 72 | | |
| Maine | 5 | Oregon | 23 | | 2,206 |
| Maryland | 23 | Pennsylvania | 26 | | |

▼

## Water as an Engineering and Industrial Material

The Edgar Marburg Lecture for 1934 delivered before the American Society of Testing Materials on the above subject by Sheppard T. Powell, Consulting Chemical Engineer of Baltimore, Md., has been published in pamphlet form by the Society. The lecture is of particular value to those concerned with industrial applications, power plants, water analysis and detection of impurities, but it is also pertinent to the general water supply field.

There is presented current thought on such problems as the following: Removal of suspended solids from water, effect of color on industrial water supplies and detrimental effect and removal of manganese. A considerable portion of the lecture discusses the treatment of water for use in boilers. The application of petrographic examination of boiler scales is indicated and the characteristic properties of minerals are described.

The section on influence of concentrated boiler-water salines on cracking of boiler steel and prevention of caustic embrittlement is important in view of the failure of many boilers from this cause.

Also discussed are the corrosion of iron and steel in steam generating systems and the reduction of corrosion losses by deaëration of water. The discovery by spectrographic analysis of lead, fluorides, zinc, and other metals in appreciable amounts in municipal water supplies is evaluated.

Copies of the published lecture, aggregating 45 pages, can be obtained from A. S. T. M. Headquarters, 260 S. Broad Street, Philadelphia, at 50 cents each.

# EXPERIENCES IN FREEZING AND THAWING OF WATER MAINS AND SERVICES

By ALBERT A. ROSS, Supt.,
*Water Works and Sewerage, Lexington, Mass.*

SINCE 1900 there have been three winters with abnormally low temperatures and that of the past year will not be soon forgotten. If we are to experience similar conditions this year, or in future years we should be prepared as far as possible in advance by having thawing equipment available, laying mains and service pipes at sufficient depths, and instructing consumers as to the prevention of freezing.

The Lexington Water Department serves a population of 12,000 through its 2,656 services. The water system comprises 73 miles of mains varying from 6 to 16 inches in diameter. In Lexington most of our freezing troubles occurred in February because the frost took sometime to penetrate sufficiently deep.

We had 137 frozen services, 348 frozen meters and 6 and 8 inch mains to freeze.

The frozen 6-in. main, installed in 1902, had been laid 6 feet deep in a solid rock trench and was cracked along its entire length. In this particular case it was necessary to shut off service from 22 families for several hours to make the necessary repairs. Two portable air compressors mounted on light trucks were used for breaking thru the frost, and after repairs to the pipe, the trench was back filled with gravel—not the frozen earth. Both the 6 and 8 inch mains were packed in mineral wool after being repaired. The fact that dead ends on mains were bled thru small orifices, prevented further trouble with frozen mains.

The majority of the service "freeze-ups" occurred between the sidewalk curb and the main, where snow had been removed to facilitate automobile travel. Whenever a meter froze it was removed for the duration of the cold period and in its place was substituted a nipple.

Services in Lexington are laid up to a depth of 4 to 5 feet, but changes in street grades reduced the depth of some of the old installations to only 3 or 4 feet. During the past summer all these shallow services have been lowered to 6 feet and we intend that all future installations, including mains, shall have six feet of cover as a precaution against possible severe weather.

Three crews of four men each were on duty thawing out services. One crew handled our portable electric unit capable of producing 200 amps. at 11 volts on 25 cycle A. C.

For longer and larger services outside the range of this unit it was necessary to hire a larger 12 KW machine, capable of producing 50 to 400 amps. with voltages varying from 5 to 60. This generator was driven by a 38 HP motor and was manned by the second crew. A welding unit is a good investment since it can be used for welding, pipe cutting, melting out joints, etc. The third crew was in charge of a mounted steam boiler which operated at 25 to 100 lbs. gage.

Because electricity provides a cheaper and quicker means for thawing frozen pipes than the other methods now in use, it is coming to be a favorite method, although it seems to have some limitations. When electrically thawing ice-filled pipes the heat generated by the flow of current through the pipe melts the ice inside. No two pipes seem to have the same resistance, even though they are thes same length and diameter. The nature of contacts established and the pipe joints have an important bearing on the resistance encountered. Generally speaking, electric thawing should not be attempted with contact wires smaller than three naught size—000.

Waterworks men generally have found that the time required to thaw by electricity varies from 3 minutes to 4 hours. Pipe resistance and likelihood of inducing current to leave the line, due to soil conductivity are among the variable factors accounting for the great difference in time required. My experience has been that between five minutes and 1½ hours is required, depending on the length of the service the capacity of the thawing machine and general conditions.

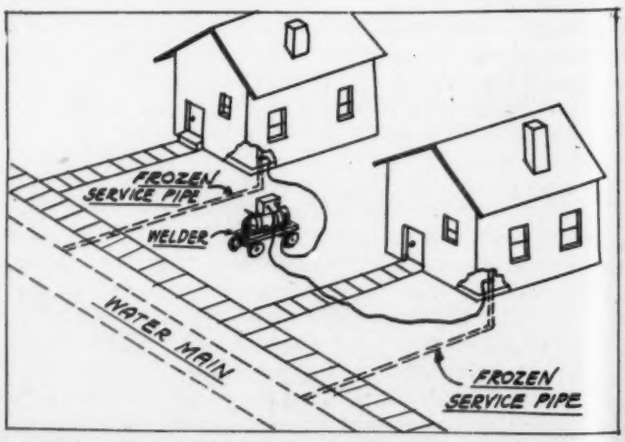
In one particular instance electricity was carried through 160 ft. of 6 inch pipe laid in 1929, the pipe having compound joints. Contacts for the apparatus were made between service connections in the cellars of two houses in the neighborhood. Another method often employed is to connect between a hydrant and a service connection. In the case of the 8 inch main referred to before, an unsuccessful attempt was made to thaw by electricity. This pipe had been laid with compound joints in 1932 and it is apparent therefore that installations having compound joints tend to become better conductors as they get older.

In order to thaw out the 8 inch main it was necessary to open sections about 200 ft. apart and apply steam through the corporation cocks.

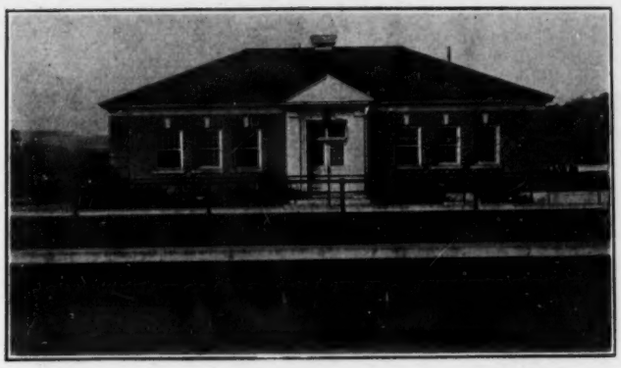
Where hydrants froze, calcium carbide in lump form was inserted through the steamer nozzle. In the case of copper services, of which we have a few, it was necessary to thaw out with hot water, or steam, since the metal offered little resistance to electric current. In a number of cases where galvanized iron services were frozen in passing through the cellar wall, a large gasoline torch was found to be effective for thawing. Wherever goosenecks (lead) froze it was necessary to excavate at the corporation cock.

Due to the high velocity of the water and the expansion of the ice tubercles were released, resulting in complaints from various sections of the town. The situation was remedied by complete flushing of the system.

*Acknowledgment*—The above represents excerpts from a paper presented by the author before the New England Water Works Association at Boston, Mass.




*Sketch showing electric thawing equipment hook-up to thaw two services. One connection may be made to a fire plug, if convenient, when only one service is to be thawed. Before turning through the current the house piping is disconnected from the service line for safety.*



*Meadville's Sewage Treatment Works. Control Building As Viewed from Settling Tanks. Note One Ton Chlorine Containers on Right.*

# MEADVILLE SEWAGE TREATMENT

By C. H. YOUNG

*District Engineer, Penna. Department of Health*
*Meadville, Pa.*

THE city of Meadville, Pennsylvania, completed and placed in operation in February, 1933, a sewage plant of the separate sludge digestion type. The sewage works improvements consist of a pump station, 800 ft. of 16 in. C. I. forcemain, settling tanks, sludge digesters, sludge beds, control building with chlorination facilities, Venturi meter, and other appurtenances.

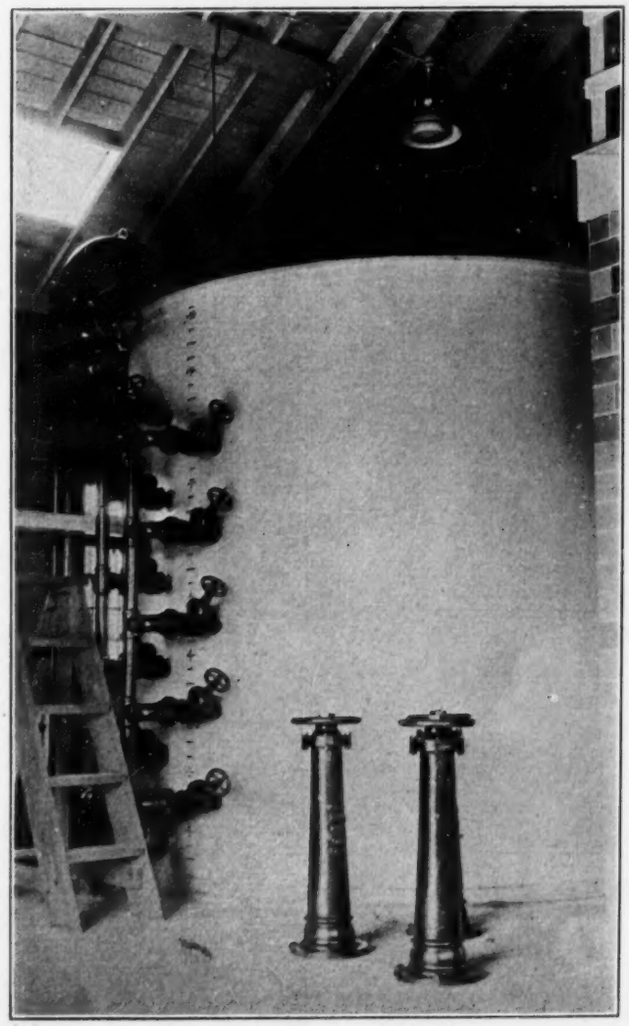
The plant was designed to receive sewage flows of 2.4 m.g.d., which compares with the present average flows of about 1.85 m.g.d. The city is served by a separate sewer system. Records of the city engineer's office show that there are about 17,500 persons tributary to the plant, which includes 500 Allegheny College students. No industrial wastes of any moment are discharged to the sewers. The construction of the sewage plant is part of a general program by the Pennsylvania Department of Health to secure treatment of all sewage discharged to French Creek, which serves as the source of public water supplies and is used at certain points for recreational purposes during the summer season.

## The Plant

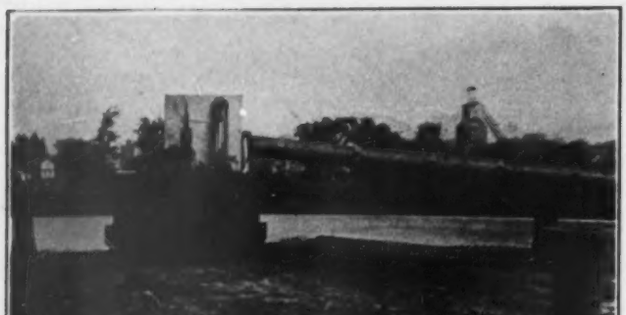
*Pump Station*—The entire sewage flow of the city is delivered to the pump station which is located at the lower end of the city. The sewage on reaching the pump station first passes through a mechanically cleaned screen 4 ft. wide provided with ⅜ in. bars spaced on 1⅞ in. centers. A time control actuates the cleaning mechanism, which cleans the bars every 10 minutes and deposits the screenings in a metal chute that discharges to two 4 cu. ft. perforated screen cans. The screenings are drained for 12 to 24 hours, which reduces the weight approximately 30 per cent, and are then incinerated at the municipal incinerator. The screenings amount to 3.3 cu. ft. per m.g. sewage treated.

From the screen chamber the sewage flows to the wet well in the pump station to be pumped to the sewage plant. A float control program device and four electrically operated pumps permit delivering the sewage to the plant at approximately the same rate of flow as received at the pump station. The pump station building is brick exterior with vitrified tile interior.

*Settling Tanks*—A Venturi tube has been installed between the pump station and the settling tanks, with the indicating, recording and totalizing mechanism located in the control building. Two mechanically cleaned rectangular settling tanks each 33 by 79 feet, with an effective depth of 7 ft. 9 in. have been constructed. The two tanks provide a 3-hour detention period on the design basis. During the summer months chlorine is ap-



*Sludge Measuring and Concentration Tanks—A Highly Useful Adjunct at the Meadville Plant.*



*Floating Cover of One of the Digestion Tanks. Dome on Floating Cover Raised 12 In. to Prevent Loss of Oil. Note Insulated Gas Line to Connection to Dome.*

plied to the screened sewage between the Venturi tube and the settling tanks.

Composite samples were secured hourly of the screened and settled sewage for a four-day period this summer, and these results show the screened sewage to contain an average of 200 p.p.m. suspended solids, and 5.3 c.c. two-hour settleable solids. The tank effluent contained 59 p.p.m suspended solids, with but a trace of two-hour settleable solids. Flows for the test period were 1.63 m.g.d. The moisture of the raw sludge as withdrawn from the settling tanks has varied from 2.9 to 8.35 per cent, averaging less than 4.5 per cent, and this sludge had an organic content averaging about 78 per cent.

*Sludge Measuring and Concentrating Tank*—The raw sludge is pumped by an adjustable plunger type pump, with a 4-speed centrifugal standby, to a measuring or concentrating tank that has a capacity equal to the maximum daily raw sludge pumping. Settling of the sludge in this tank from 1 to 3 hours permits decanting 15 to 40 per cent of the separated liquid before the remaining sludge is pumped to the digesters. The decanting is done by a series of valves spaced on 9 in. centers vertically. This tank (see illustration) permits inspecting and sampling of the raw sludge in full view of the operator and provides a point for adding lime if necessary. It supplies a simple and positive means for measuring the volume of sludge removed daily and computing therefrom the solids handled.

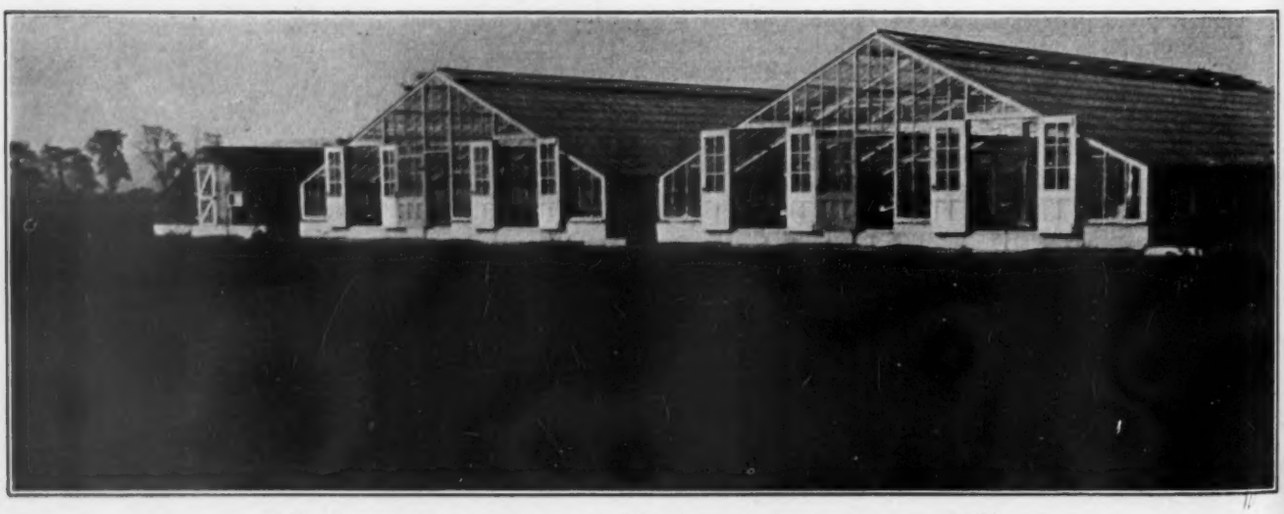
*Digesters*—Each digester is 35 ft. in diameter by 21 ft. in effective sidewall depth, which gives a total capacity of about 40,000 cu. ft. exclusive of the hoppers. The tanks are provided with floating covers (illustrated) which serve as gasometers. They are heated by means of 2 in. galvanized W.I. coils located near the bottom and around the inside perimeter of the tank. The sidewalls and cover of the tank are insulated. The tanks are partly elevated and are banked with earth as a means of further minimizing temperature losses.

The digesters have produced a considerable volume of gas averaging about 1 cu. ft. per capita, the gas being measured at a water pressure of 3 to 3½ inches. The $CO_2$ content has varied from 29.3 to 35 per cent with little difference between the two tanks. Three gas analyses were made for heating value, these showing a B.t.u. value of 688, 627 and 661 per cubic foot.

*Sludge Drying Beds*—The digested sludge is drawn by gravity to three sludge drying beds, two of which are glass covered and have a sand area of 5,700 sq. ft., while the open bed has a sand area of 1,450 sq. ft. The dried sludge is removed by hand to a bucket carrier (see illustration) which operates on a monorail system, so arranged that the dried sludge can be conveyed to the loading platform or to the dump. The digested sludge drawn to the beds to a depth of 10 to 12 inches will dry in 12 days on either the open or closed bed during the best drying weather. During winter, from four to eight weeks are required for drying the same depth of sludge on the glass covered beds.

Sludge applied to the beds has varied from 7.25 to 11.7 per cent solids, having an organic content of about 47.5 per cent. About 1,030 cu. yd. of digested sludge has been drawn to the beds during the past year, and in addition an unestimated amount of sludge has been wasted to a borrow pit back of the plant.

*Chlorination*—A separate chlorination room containing a 300 lb. per day capacity manually controlled vacuum feed chlorinator and an 8,100 lb. platform scales has been provided in the control building. Adjacent to the chlorination room and on the same level is a concrete chlorine storage platform of sufficient size to hold a carload of ton chlorine containers. Chlorine in ton containers is used during the summer months. Records show that 124 lb. of chlorine per m.g. sewage treated have been used this past summer. The rate of chlorination is varied manually three times daily and a chlorine residual, generally between 0.15 and 0.6, is maintained.



*The Covered Sludge Beds and Experimental Drying Bed (at Left.)*

*Control Building*—The control building houses the laboratory, chlorination facilities, lime storage and lime dry feed, concentration tank, toilet, workshop and garage. In the basement are the two sludge pumps, hot water heating system with appurtenances for heating the digesters, and four gas meters for measuring the gas produced and used. A panelboard located in the lobby contains the Venturi recording mechanism and four thermometers. Two thermometers record the temperature at the midpoints of each digester, whereas the other two record the temperature of the feed and return water to each digester.

## Operating Procedure

*Operating Procedure*—The mechanism in the settling tanks is operated each morning and raw sludge is pumped to the concentration tank until the sludge being delivered thins to about 1¼ per cent solids. For the past year the raw sludge has been pumped to No. 1 digester and each day or every other day the middle or bottom sludge is withdrawn to No. 2 digester. All supernatant liquid is drawn from No. 2 digester and is returned to the influent of the settling tanks, or else sludge is withdrawn to make room for the incoming solids from No. 1 digester. On a volume basis No. 1 digester is operated on about a 30-day (primary) digestion period. Approximately 87 per cent of the total gas is produced from No. 1 digester. The scum in this tank is hosed regularly to prevent scum forming to great depth. Digester No. 2 has been free of scum at all times.

Heat has been applied to No. 1 tank only, the present temperature being maintained between 83 and 85 degrees F. The pH of both tanks holds around 7.0, and little lime has been added.

The principal operating difficulty has been the marked decline in gas production in No. 1 tank on several occasions related to a change in tank temperature, too infrequent hosing of scum, or a combination of the two.

## Costs

The plant including the pump station, forcemain and land, cost complete about $135,000—$26,250 per M.G. capacity. It is operated by one full-time operator and a part-time assistant. Operation includes running the plant and the ordinary maintenance incident thereto, making plant control tests, keeping plant records, mowing the lawns and caring for the shrubbery during the summer season.

The operating cost of the plant for the past year has been 29 cents per capita, whereas the pumping costs have been 20 cents per capita, the total cost being $8,500 or 49 cents per year for each connected person. The operating costs do not include any fixed charges, because the funds for construction of the plant were raised through an annual millage set aside for this purpose.

The sewage plant is operated by the City Department of Streets and Public Improvements, under the supervision of City Engineer R. L. Phillips.

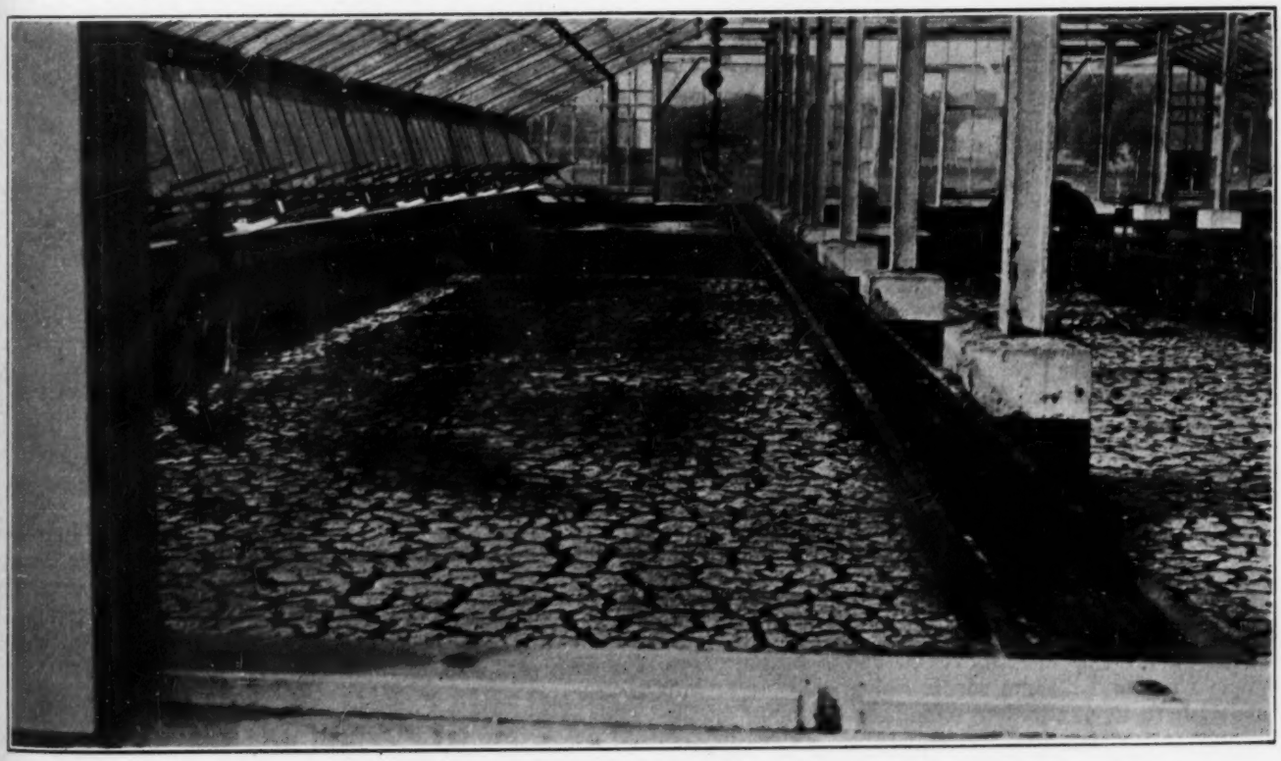
▼

## Treating Laundry Wastes

Experimental work to devise and evaluate methods of purifying laundry wastes at Texas A. & M. College included treatment of the wastes with chemicals and oxidation by filtration. Of the chemicals used, ferric chloride proved the most satisfactory but adjustment of the pH of the waste to 6.6-6.4 with sulphuric acid was essential for most economical chemical treatment. Biochemical oxygen demand was reduced 85 to 90 per cent and a clear, stable effluent resulted.

A trickling filter 6 feet deep was operated for a five-months' period at various rates. At a rate of one million gallons per acre per day 75 per cent reduction in biochemical oxygen demand was obtained. Such an effluent, however, was stable enough to discharge into the stream. A Dunbar filter was found to be less efficient.

Report of the investigation with conclusions are covered in Bulletin No. 42 recently issued by the Texas Engineering Experiment Station at Texas A. & M. College, College Station, Texas. Title: *"The Treatment of Laundry Wastes."*—J. A. Boyer.



*Interior of Well Designed Sludge Beds.*

*Fig. 7—Vacuum Filters and Continuous Sludge Conditioning Tanks at Hagerstown, Md., Sewage Treatment Works*

# PRACTICAL ASPECTS OF STORING AND HANDLING FERRIC CHLORIDE

By J. M. POTTER*

*Philadelphia, Pa.*

THE steady advance in the utilization of chemicals in sewage treatment has created an increasing interest among engineers and municipal officials in the problems involved in their use.

The object of this article is to supply a concise outline of the more significant properties of ferric chloride and effective methods of handling and storing it.

At this time there are three commercial forms of ferric chloride available:

1. *Liquor*—An aqueous solution which is prepared to contain between 39 and 45 per cent $FeCl_3$ by weight to meet exact specifications.
2. *Crystals*—A definite crystal of the formula $FeCl_3.6H_2O$ containing 60 per cent $FeCl_3$ by weight.
3. *Anhydrous*—A complete water-free form containing 98 per cent or more $FeCl_3$ by weight.

## Liquid Ferric Chloride

Commercial ferric chloride liquor is a dark brown, somewhat oily appearing aqueous $FeCl_3$ solution of varying concentrations. Obviously for the lowest transportation cost, the $FeCl_3$ content of these solutions should be as high as possible but concentrations are limited by crystallizing temperature conditions during transit or storage. To prevent crystallization the strength of solutions usually varies from 45 per cent in midsummer to 39 per cent $FeCl_3$ in midwinter. Average concentration of shipments over a period of several years has been 42 per cent.

Shipments are made in rubber-lined tank cars holding 8,000 gallons and averaging 40,000 pounds of dissolved $FeCl_3$ per car. The dome of the tank car is equipped with sump and center level discharges, a filling and air pressure pipe with gauge connection and a rubber disk safety valve which relieves at gauge pressures exceeding 25 pounds. The car is unloaded by attaching a rubber hose to the discharge connection and siphoning in case of low level storage tanks or by applying air pressure up to 25 pounds where a lift is required.

*The maximum lift by air ejection is limited to* 40 *feet. If higher lifts are necessary a suitable pump should be provided.*

Ferric chloride liquor (referred to in the trade as liquid ferric chloride) is easily handled and is usually the most economical form for use by the large consumer, who is reasonably near a source of supply. However, it has the disadvantage of requiring transportation costs on its 58 per cent (average) water content, railroad siding facilities, and storage tanks for one or more cars.

## Storage Tanks

Except for its strongly corrosive nature, ferric chloride liquor offers no storage hazard, the only storage problem being provision of sufficiently large ferric chloride resistant tanks to store one or more carloads. *Ten thousand gallons should be the minimum storage capacity for plants using tank cars of ferric chloride.* Wood, reinforced concrete, or steel tanks lined with rubber with all exposed exterior surfaces painted with a ferric chloride resistant paint are the ideal containers. Covered tanks need not be sheltered but, in the case of unsheltered tanks, the strong liquor received during war weather should be diluted in the storage tanks during the colder months to prevent crystallization. If possible, storage tanks should be elevated to permit the liquor to flow by gravity to dilution tanks or feeders, thereby confining all pumping to the simple air lift unloading operation from the car.

The concentrated ferric chloride solution taken from storage is preferably diluted to a 2 or 3 per cent solution when applied by one of the methods noted later in this article under "Feeding Equipment." Fig. 1 pictures dual rubber-lined wood tanks under cover at the Sewage Treatment Works of Milwaukee.

## Crystal Ferric Chloride

Crystal ferric chloride is the oldest commercial form. As indicated in Fig. 2, four hydrated crystals of ferric

*Chemical Engineer, Technical Service Dept., Pennsylvania Salt Manufacturing Co., Philadelphia, Pa.

*Fig. 1—Rubber Lined Storage Tanks Holding Ferric Chloride Lqiuor at the Milwaukee Sewerage Treatment Commission Treatment Plant*

chloride can be formed; but, only the dodecahydrate, $Fe_2Cl_6.12H_2O$, (commonly written $FeCl_3.6H_2O$) is now commercially available. This material contains 60 per cent $FeCl_3$ by weight, is in the form of large yellow or brown lumps, has a melting point of 98.6° F., is slowly soluble in water at average tap temperatures, and is moderately hygroscopic.

The crystals are marketed in non-returnable, hardwood, paraffine-lined barrels of 55 gallons capacity, which contain approximately 435 pounds of material. To prevent melting, and possible leakage, it is advisable to store barrels in single tiers under dry conditions at temperatures below 98.6° F. *The storage space required is approximately 70 square feet per ton of $FeCl_3$.*

Equipment for prepartion of solutions and feeding crystal ferric chloride will be discussed in connection with anhydrous ferric chloride solutions, because of the close similarity of each.

## Anhydrous Ferric Chloride

Anhydrous ferric chloride occurs rarely in nature, possibly the only source being the lava of Vesuvius. It takes the form of small greenish-black crystals with a melting point of 577.4° F., and is extremely hygroscopic, being readily soluble in water to 45 per cent concentrations at room temperatures above 55 degrees. (See Fig. 2.)

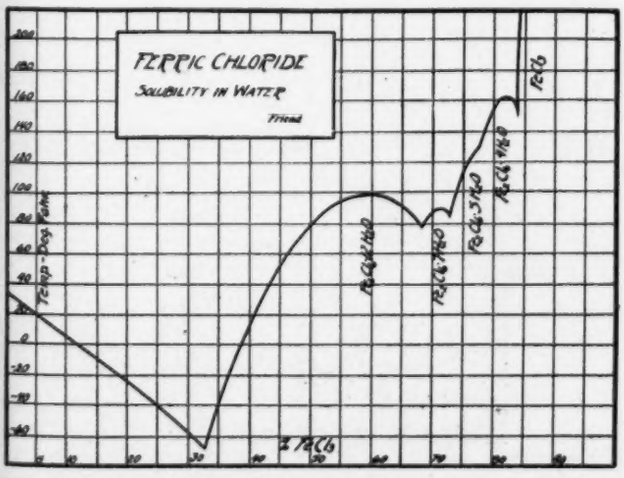



*Fig. 2—Illustrating the Degree of Solubility of Ferric Chloride at Varying Temperatures. Note That a 45 Per Cent Solution Will Crystallize at About 52 Degrees F.; a 33 Per Cent at Zero*

At present, the anhydrous form is being shipped in non-returnable steel drums holding 150 pounds of material. The drums, 15½ inches in diameter by 20 in height and weighing 10 pounds, are fitted with a 9-inch air-tight gasket and lid held in place by 4 screw bolts. These drums are convenient packages which may be stacked as shown in Fig. 3 and stored indefinitely without deterioration. *Storage space required is approximately 40 cubic feet per ton of $FeCl_3$.*

Anhydrous ferric chloride has a decided advantage over the other forms by reducing transportation costs and storage space requirements 40 per cent or more. In addition, waste by leakage or deterioration is eliminated.

## Preparation of Solution, Feed Methods and Equipment

The hygroscopic character of ferric chloride prohibits the use of dry feeds. The corrosive nature of solutions prevents the use of ordinary piping and feeding equipment. A 20 per cent ferric chloride solution rapidly attacks the common metals and dehydrates wood, causing it to warp and shrink. Wood, or reinforced concrete, resists the action of weak solutions since excessive

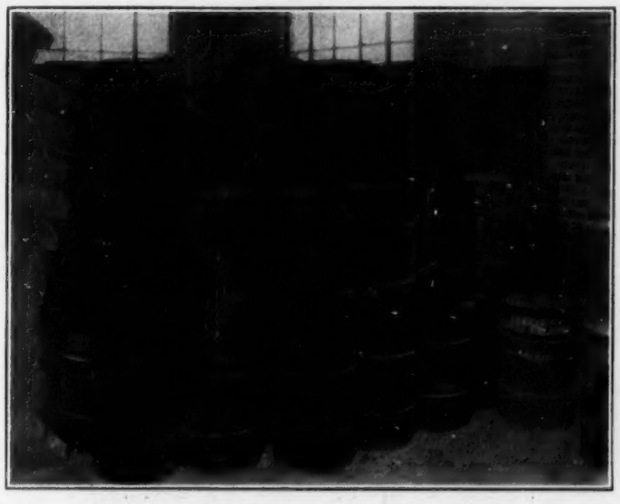


*Fig. 3—Tier Storage of Anhydrous Ferric Chloride Drums at Hagerstown, Md., Sewage Disposal Plant*

hydrolysis forms a protective hydrate coating. Equipment made of, or lined with, rubber, glass, Bakelite, or ceramic material, or the resistant metals such as Durichlor, or Hastelloy "C," will resist all concentrations of ferric chloride at normal temperatures. Rubber, glass, or ceramic materials may require additional protection against mechanical abrasion, or heat variation.

Feeding apparatus may vary from a simple solution tank with constant head orifice box to a modern "electric eye" controlled installation such as that used at the Chicago Sanitary District and illustrated in Fig. 4. The ideal and foolproof method of feeding involves 3 distinct steps: (1) Solution, (2) Dilution, (3) Application.

## Dissolving Tanks

Solution tanks are necessary for dissolving either the crystal or anyhydrous ferric chloride. Concentrations of less than 40 per cent are recommended to prevent crystallization and, in the case of anhydrous ferric chloride, high temperatures at the time of preparing the strong solution.

Solution strengths should be determined by adding a weighed quantity of ferric chloride to a definite volume of water as hydrometer measurements have proved to be

unreliable. The tank should be at least party filled with water before adding anhydrous ferric chloride to prevent the formation of the slowly soluble higher crystals and if the total contents of a drum are not added at one time the lid should be tightly replaced. Solution tanks of steel, reinforced concrete, or wood, lined with rubber and faced with acid-proof brick and cement, and of sufficient size to dissolve a 12 hour supply of ferric chloride, are preferable. A material rack or compartment and mechanical means of agitation are desirable features. Fig. 5 illustrates such a tank in connection with a pump which serves the dual purpose of agitating and lifting the concentrated liquor to the dilution tank above. Fig. 6 shows a similar tank in use at Hagerstown, Md., where the solution is raised to the dilution tank by a vacuum lift.

## Dilution Tanks

Dilution tanks are advisable for preparing and supplying uniform solutions to feeders. Concentrated solutions are diluted to 3 or 4 per cent $FeCl_3$ by adding

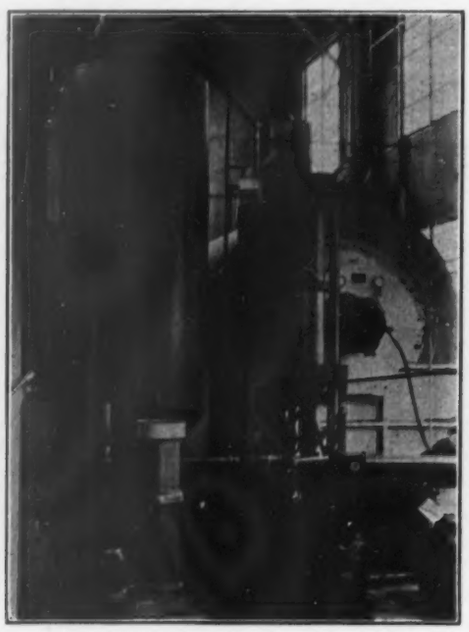


*Fig. 4—Filter and Sludge Conditioning Tank Controlled by Electric Eye at the West Side Plant—Chicago Sanitary District*

gauged volumes of water and liquor. Experience indicates that stronger than 5 per cent solutions exhibit intense localized reaction on application and solutions weaker than 2 per cent may be appreciably hydrolyzed, especially by diluting waters of high alkalinity. Dilution tanks may be similar in construction to solution tanks without the acid-proof brick facing. Reinforced concrete tanks painted with a ferric chloride resistant paint, or large stoneware crocks are suitable. Other desirable features would include a mechanical stirrer, a graduated gauge rod, or glass, and a capacity for at least 4 hours' supply of solution. A tank with the depth exceeding other dimensions is preferable for more accurate gauging.

## Solution Feeder

A positive displacement or a variable siphon head type of solution feeder is recommended for applying ferric chloride solutions. Several such corrosion resistant feeders, which have entirely corrected the uncertain performance peculiar to the old orifice type feeder, are on the market today. These feeders may be either man-

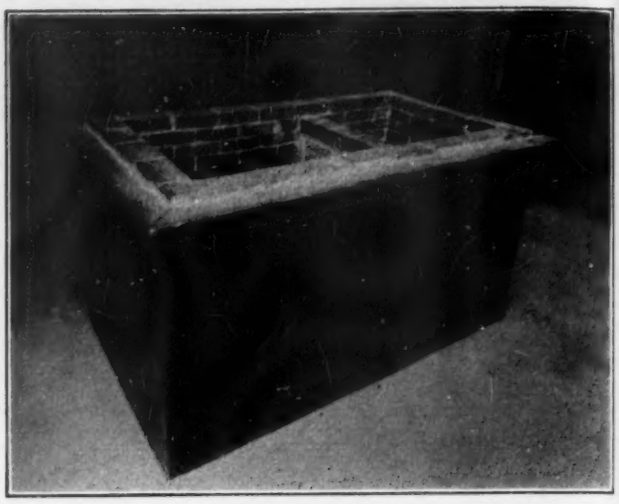


*Fig. 5—Ferric Chloride Dissolving Tank at Hagerstown, Md., Sewage Treatment Works*

ually or automatically regulated. Space does not permit even a limited discussion of all such feeders but following is a list of manufacturers: Builders Iron Foundry, Providence, Rhode Island; Galigher Company, Salt Lake City, Utah; Hills-McCanna Co., New York City; Omega Machine Co., Kansas City, Mo.; Phipps & Bird, Inc., Richmond, Va.; Wallace & Tiernan, Inc., Newark, N. J.

Obviously, a gravity flow from solution tank to the final point of application is the ideal feeding arrangement. When lifting is necessary, any method which employs ferric chloride resistant materials may be used. Rubber-lined or hard rubber pumps, pipe and fittings are

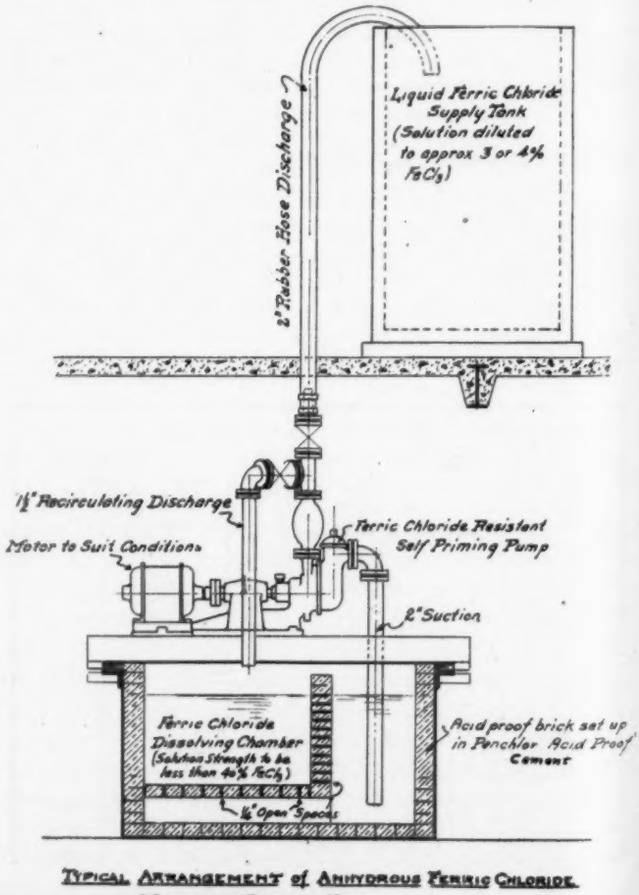

2" Rubber Hose Discharge
Liquid Ferric Chloride Supply Tank (Solution diluted to approx 3 or 4% FeCl3)
½" Recirculating Discharge
Motor to Suit Condition
Ferric Chloride Resistant Self Priming Pump
2" Suction
Ferric Chloride Dissolving Chamber (Solution Strength to be less than 40% FeCl3)
Acid proof brick set up in Penchlor Acid Proof Cement
½" Open Spaces
TYPICAL ARRANGEMENT of ANHYDROUS FERRIC CHLORIDE MIXING AND PUMPING UNIT

*Fig. 6—Sketch of Trouble Free Equipment and Method of Dissolving, Diluting and Feeding Ferric Chloride*

satisfactory for handling ferric chloride solutions at normal temperatures. Equipment made of Durichlor, or Hastelloy "C" is recommended for hot solutions.

For simple coagulation of sewages with ferric chloride, water purification practice for flocculation and sedimentation will give the best results. For sludge conditioning, rapid agitation for 5 or 6 minutes followed by continuous filtration is preferable to the batch method. Fig. 7 shows small mixing tanks used for this preferred method at Hagerstown, Md.

▼

## P.W.A. Plans to Eliminate Rock Creek Pollution

The Public Works Administration has allotted $25,000 for a study with a view to the elimination of pollution of Rock Creek which drains an area of 75 square miles in the District of Columbia and contiguous Maryland territory.

Twenty-five Maryland communities contribute to the pollution of this creek which empties into the Potomac River at a point opposite Theodore Roosevelt Memorial Island. PWA already has made a loan and grant of $4,000,000 to the District of Columbia for construction of a sewage disposal plant for Washington and action to eliminate Rock Creek pollution constitutes a part of the general plan for improvement of the insanitary condition of the Potomac River.

The study will be made by the National Park Service, (Department of the Interior) which will recommend to PWA a plan of sewage and waste treatment for this project.

▼

## Water for Sale—Fourteen Barrels for 13 Cents

Which had the average consumer rather buy, 100 cubic feet of water for 13 cents or fourteen barrels of water for the same 13 cents? It is apparent that the Bureau of Water of Los Angeles realizes the psychology of the matter because while they bill household users at 13 cents per 100 cubic feet read on the meter they "sell" them better than fourteen 52 gal. barrels of water for 13 cents. After all, Los Angeles water brought in from a distance of more than 250 miles from the snow covered Sierra Nevadas, is impressively cheap at less than 5 cents a ton delivered to the consumer's home at all hours night or day. This regardless of the billing per 100 cu. ft. Perhaps this bit of psychology in selling water has, among other things, kept the Los Angeles Department of Water Supply clear of political injection or interference and effectively appreciated by its customers.

▼

## A.S.T.M. Tentative Standards (1934 Edition)

This publication issued each year by the American Society for Testing Materials is the only volume containing all of the A. S. T. M. tentative specifications, methods of test and definitions of terms covering engineering materials and the allied testing field. These *tentative* standards, issued as *proposed* standards, embodying the latest thoughts and practices, find important applications throughout industry.

The 1934 edition of the book (1250 pp.) contains 236 tentative standards. Of these, 48 are included for the first time, while some 60 were revised this year and are given in their latest approved form.

New tentative specifications published for the first time in 1934 cover the following: Electric-fusion-welded steel pipe; alloy-steel castings for valves, flanges and fittings; seamless alloy-steel pipe; sheet-copper silicon alloy for fabrication rods, plates, sheets, etc.; portland cement mortars (compressive strength test), sodium silicate for curing concrete; fuel oils; various types of emulsified asphalts; insulated wire and cable (class A, 30 per cent Hevea rubber compound); creosote and creosote coal-tar solution.

Extensive revisions have been incorporated in the requirements for cold-rolled strip steel; black and hot-dipped zinc-coated welded and seamless steel pipe for ordinary uses; reinforced and non-reinforced concrete sewer pipe; timber piles; friction tape for general electrical use.

In addition to the 236 A. S. T. M. tentative standards, the 1934 Book of Tentative Standards includes all proposed revisions of standards, which are published to elicit criticism before final adoption. Changes in 60 standards have been proposed.

To facilitate the use of the book a complete subject index has been included, listing items under the materials and subjects to which they apply; and two tables of contents are given, one listing the standards in the order they appear (grouped under general subjects) and the second listing the items in numeric sequence of serial designations.

Copies in cloth binding at $8.00 each, or in heavy paper cover, $7,00, can be obtained from A. S. T. M. Headquarters, 260 S. Broad Street, Philadelphia, Pa.

▼

## Association Meetings Scheduled

Jan. 15—**New York State Sewage Works Association.** Hotel McAlpin, New York City. Secretary, A. S. Bedell, State Departmet of Health, Albany, N. Y.

Jan. 16-18—**American Society Civil Engineers.** New York City. Secretary, Geo. T. Seabury, 33 West 39th Street, New York City.

March 7-8—**Indiana Section A. W. W. A.** Hotel Antlers, Indianapolis, Ind. Secretary, B. H. Jeup, State Division of Public Health, Indianapolis, Ind.

March 11-13—**Kentucky-Tennessee Section A. W. W. A.** Lexington, Ky. Secretary, F. C. Dugan, State Board of Health, Louisville, Ky.

March 21-22—**New Jersey Sewage Works Association.** Stacy Trent Hotel, Trenton, N. J. Secretary, John R. Downes, Bound Brook, N. J. Treasurer, Paul Molitor, Jr., Morristown, N. J.

March 27-29—**Canadian Section A. W. W. A.** Hotel London, London, Ont. Secretary, A. E. Berry, Ontario Department of Health, Toronto, Ont.

April 2-4—**Southeastern Section A. W. W. A.** Hotel Tutweiler, Birmingham, Ala. Secretary, W. H. Weir, State Department of Health, Atlanta, Ga.

April 10-11—**Illinois Section A. W. W. A.** Springfield, Ill. Secretary, A. E. Skinner, Pitometer Company, 5311 Kenmore Ave., Chicago, Ill.

April 12-13—**Montana Section A. W. W. A.** Helena, Mont. H. B. Foote, State Board of Health, Helena, Mont. (Water Works School to be held April 10-11.)

**May 6-10—Annual Convention of A. W. W. A. Hotel Netherland Plaza, Cincinnati, Ohio. Secretary, B. C. Little, 29 West 39th Street, New York City.**

May 16-18—**Pacific Northwest Section A. W. W. A.** Lewiston, Idaho. Secretary, E. C. Willard, 720 Corbett Bldg., Portland, Ore.

Oct. 14-17—**Southwest Section A. W. W. A.*** Houston, Texas. Secretary, Lewis A. Quigley, Supt., Water Works, Fort Worth, Texas.

(*Former Southwest Water Works Assn.)

Oct. 23-26—**California Section A. W. W. A.** San Diego, Calif. Secretary, J. E. Phillps, Department of Water and Power, Los Angeles, Calif.

# COMPARATIVE NOTES ON FIELD JOINTS FOR LARGE DIAMETER STEEL PIPE

## (Part 2)

## Based on Recent Installation of 32-Inch Steel Supply Main at Fort Wayne, Ind.

By W. C. CURD

*Consulting Engineer,*
*Cincinnati, O.*

**Part 1 of this article which appeared in the December issue of WATER WORKS AND SEWERAGE, described the installation of the 42 Inch Steel Supply Main at Fort Wayne. The author described practical methods developed in the field for laying and jointing the pipe, labor-distribution, field-coating, etc. Based on his varied and long experience in laying large diameter steel pipe lines, he cited practical comparisons between the several types of joints previously employed and the Dresser type used on the Fort Wayne project.**

**In this second part of his article Mr. Curd relates additional experiences on the Fort Wayne project, including methods of and results from making leakage tests, the method of making a river crossing and other unusual features of the project.**

**The author of this article, for many years a consulting hydraulic engineer, has specialized for the past 10 years in the design and construction of large diameter steel pipe lines. An author of ability, he was awarded the A. S. C. E. James Laurie Prize for one of his papers, printed in its Proceedings for 1921.—Editor.**

### Leakage Tests and Notes Thereon

The following is quoted from the engineer's specifications on subject of hydrostatic field tests on the Fort Wayne Supply Main:

"The raw water supply main shall be tested by filling with water and, after the entrained air within the main has been removed or absorbed, by then subjecting the line to one or more tests. The pressure in the section of main under test shall be brought up to 100 pounds per square inch, and without further admission of water, air or other disturbance of conditions, the pressure shall be observed over a period of six hours. If the observed final pressure at end of six hours is less than 75 pounds per square inch, the test shall be considered to be void and further efforts shall be made to remove entrained air from the main, after which the test shall be repeated until a test is made in which the observed final pressure is not less than the specified value. At the end of the six hour period during which the pressure does not drop below the specified final pressure, sufficient water shall be pumped into the section of main under test to restore the pressure to its initial value. The volume of water so added shall be measured and shall be considered to represent the leakage in the section under test during the interval. *Under such conditions the leakage shall not exceed 2 gallons per 100 lineal feet of main per hour.*"

To insure acceptable tests, in the manner specified, unusual care had to be exercised to free the line of air for unless this was done, a hundred per cent tight line, so far as leaky joints and connections were concerned, could not show up favorably, due to a continual absorption of air under pressure. This naturally would register as a pressure drop or as leakage when the quantity of water for restoring the 100 pounds pressure was measured.

Entrained air will not readily flow long distances in quiet water to high points in a line, due to pockets being formed wherever a pipe section settles slightly below grade. According to experience with all-riveted lines, air can and does escape through the many thousand rivets in the numerous seams but where welded pipe and

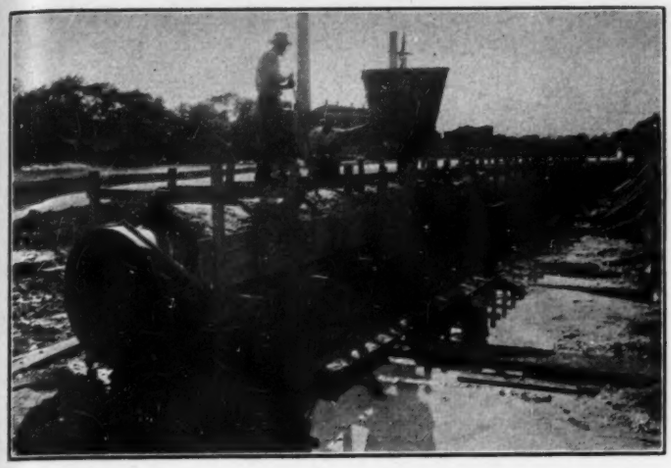


*Plate 6—River Bed Crossing Section of 42 In. Pipe Assembled on Bank Being Covered with 6 In. of Concrete*

welded joints or Dresser couplings are used, the only points of escape are at the joints and through valves specially provided for releasing air. Since Dresser couplings are practically leakproof when properly installed, more care must be exercised by providing ample facilities at proper points for releasing the entrained air when making tests for tightness of such lines.

This fact was recognized in planning the Fort Wayne pipe details, by specifying that an 1½ in. drop hole, closed with a threaded plug, should be furnished by the manufacturer in one end of each fourth section of pipe, over the entire line. Unfortunately, in laying the line, some of the gangs ignored these plugs and as a result, many of them were found to be left in a position of no use for releasing air.

Another condition which increased the quantity of air to be contended with, was the fact that cold well water was used for filling the line. This water remained in the line for several days and, as its temperature increased, dissolved air and carbonic acid gas were continually being released to lodge in pockets at numerous places along the stretch under test. The air did not move to the high points where air release valves had been installed.

Practically all of the tests were conducted against valves at one end of each stretch. These valves could not be made absolutely water tight, but where possible, the leakage through them was measured and allowed for. This accounts for the lack of closer agreement in the result of the tests as a whole.

In Table II will be found a tabulation of all the tests conducted, the locations being shown in Fig. 1.—"Condensed Plan and Profile of the Fort Wayne Supply Main."

Hazards and ground conditions were such at Fort Wayne, that most or all of the joints, in each of the stretches tested, could be left exposed, and this afforded excellent opportunities for inspecting them while the tests were under way. In Tests Nos. 1, 2, and 4, all joints were exposed but in Nos. 3, 5 and 6, only a portion were left uncovered.

Out of a total of 309 couplings installed in the 42 inch line but two leaky joints were found, these being included in Test No. 3. The leaks were at the bottom of two joints and were caused by the gasket retaining rim in the outer ring or follower lodging against the edge of the center-ring. The sole reason for this was carelessness on the part of the bolters in not seeing that the rim had slipped over the center ring. However, stopping the leaks was a very easy matter. After about

TABLE II—SUMMARY OF FORT WAYNE TESTS.

| Test No. | Length, ft. | Pressure drop in 6 hours, lbs. | Allowable leakage, gal. | Actual leakage, gal. | Per cent under allowances | Remarks |
|---|---|---|---|---|---|---|
| 1.... | 3031.74 | 40 | 363.8 | 138.3 | 62 | Leaky valves at each end. Leakage measured at rate 5.6 gal. per hr. |
| 2.... | 1289.75 | 30 | 154.7 | 57.6 | 62.7 | Bulkhead on one end and leaky valve at other. |
| 3.... | 2366.7 | 45.4 | 284.0 | 129.6 | 54.4 | Bulkhead one end and 36 in. valves the other. Two leaky joints in this stretch. Limited air release facilities. |
| 4.... | 2369.29 | 15 | 284.3 | 46.3 | 83.7 | Bulkhead one end and 36 in. hydraulic valves on other. Ample air release facilities. |
| 5.... | 2337.99 | 29 | 280.5 | 158.3 | 43.5 | Bulkheads each end. Includes 20 floated sections. Limited air release facilities. No leaks found. |
| 6.... | 1257.75 | 60 | 150.9 | 131.3 | 13 | Bulkhead one end and leaky 36 in. valves other. Leakage measured at 10 gal. per hr. When pumping at 100 lb. pressure leakage increased to 235 gal. per hr. |

half the bolts on each side of a leaking joint had been loosened, the ring snapped into place and when the bolts were retightened, no further leaks appeared, with the full 100 pounds pressure applied.

## Backfilling

With the exception of these two leaks, there was no evidence whatsoever of any sweating or air escaping at any other of the joints, which were exposed and could be examined. This demonstration leads the writer to

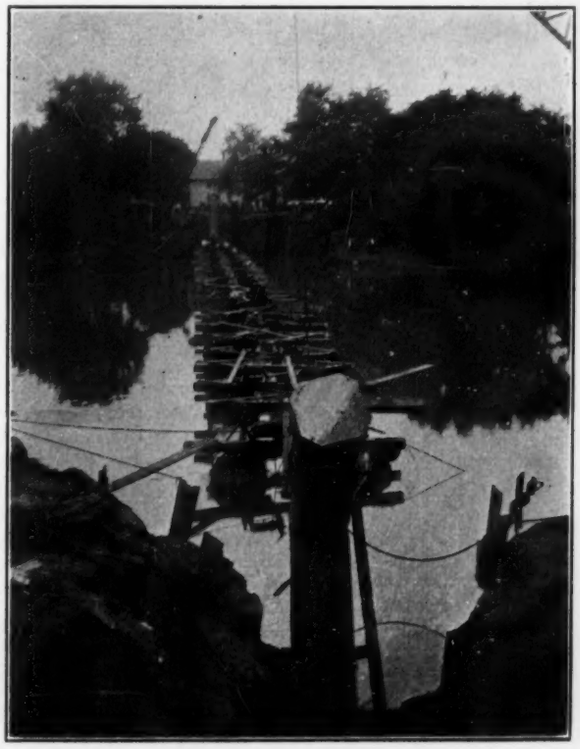


*Plate 7—St. Joseph River Crossing—Concrete Covered 42 In. Line Suspended by Pontoons Ready for Lowering. Pontoons Made of Pipe Closed at Ends with Dresser Couplings*

the conclusion that, where competent and careful bolters are employed and their work is inspected, complete backfilling, with a Dresser coupled line, may proceed with the laying and bolting operations. Such assurance, I feel, cannot be enjoyed with other types of joints where more complicated operations allow more chance for human error to creep in.

## Pipe Floated by Heavy Rain

Quite a severe test on the Dresser couplings came about through an incident, near the close of the work. Early one morning an exceptionally heavy rain, lasting one hour, flooded the open trench about midway of a test stretch, broke several sewers crossing it and caused twenty 40 foot sections of pipe to float. The maximum rise was about eight feet at the lower end of the affected length but in the entire twenty sections, as remarkable as it seemed, not a single joint was damaged nor had any pipe section slipped entirely out of its coupling. The trench was dewatered, the caveins removed with clamshell and the pipe undercut by hand, section by section, until each one settled gradually back to grade. Only one section had to be removed and relaid and this was treated as a closure, where it connected with the undisturbed portion of the line. The pipe was weighted by partially filling it with water and the bolts in each coupling were loosened, which aided in putting the floated sections back to grade.

Plates 2, 4 and 5 are made from snapshots of the floated sections. Plate 4a is a view along the trench affected, before it was dewatered but after the water had receded somewhat from its maximum height. Plate 4b is a view of the sections, where the greatest raise occurred and Plate 5 is a close-up of the joint which took the maximum deflection. The amount of this joint opened up, without the pipe slipping entirely out of the coupling, is very apparent from this picture.

After the line was put back to grade, all of the twenty sections affected were left fully exposed until after test and not a leak could be found in any of them. However, due to the softened condition of the trench bottom, some settlement below grade occurred in a few of the sections and caused air to pocket at points where there was no provision for releasing it, which accounts for results of Test No. 5 (recorded in Table II) being somewhat below the average.

*Plate 4—Condition of Pipe Line Following Trench Flooding. (a) Left: Showing Section of 20 Pipe Lengths Which Floated. (b) Right: Section Which Had Maximum Raise from Floating—About 8 Ft.*

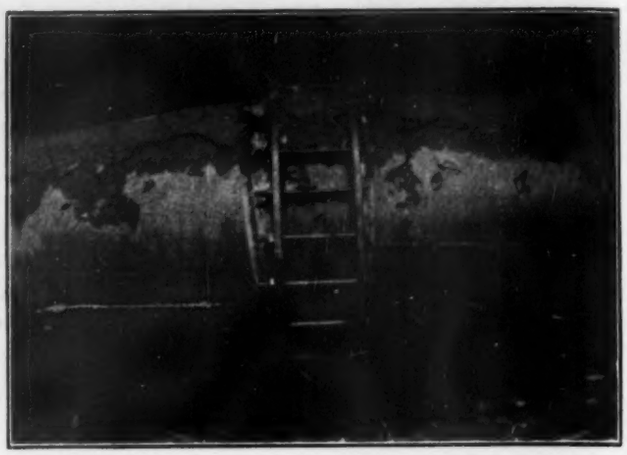


*Plate 5—Close-up of Joint Showing Maximum Deflection in Floating of Line in Trench. Note That the Pipe End Did Not Come Out of the Coupling Collar*

## St. Joseph River Crossing

A unique and successful method for installing the line under the St. Joseph River, was made practical through the use of Dresser couplings and other material on hand, which were later salvaged and incorporated in the line at other points.

First, a part of the main to be installed, the river bed section, approximately 250 feet in length, was assembled on the bank above the crossing and after all joint connections had been made, it was coated with concrete to a thickness of 6 inches—see Pl. 6.

Next, two pontoons, each composed of six 40 ft. sections of straight pipe, were built up by employing Dresser couplings with ends closed with light steel bulkheads, as illustrated in Pl. 7. With wooden decking and a number of winches, the assembled concrete coated line was suspended between the two pontoons and the entire structure put afloat.

While the assembling of pipe and pontoons was underway, two dragline machines, operating scrapers and buckets from each bank, were at work dredging the river bed to grade, to a depth 20 ft. below water surface. When the grade had been completed, the pipe and pontoons were floated to the point of crossing and anchored in exact position for line and stationing. Then, with all winches manned (see Pl. 7), the assembled pipe line was slowly lowered. When about half way down, the two bank elbows were attached and the entire crossing (318 feet in length), was then put to grade, without the aid of cofferdams, piling or other accessories usual to this class of work. Afterwards the pontoons were taken back to the point of assembly and dismantled, the pipe and couplings being returned to their respective locations in the line, thus providing an unusually economical and simplified method of pontoon construction without waste or damage to the pipe used.

The river bed joints were riveted, with inside and outside girt seams and inside rivet heads electrically welded to unite the entire structure into one single length. The bank elbows and all other sections were connected with couplings.

## Pumphouse, Valve-Chamber Connections

The contract for the 42 in. pipe line, proper, terminated near the dam with a leaded connection into a valve chamber. The construction of the chamber, furnishing and setting five 36 in. valves and nipples and furnishing and laying two 36 in. lines from the chamber to the pumphouse in the dam structure, were included in a separate contract for the erection of the dam.

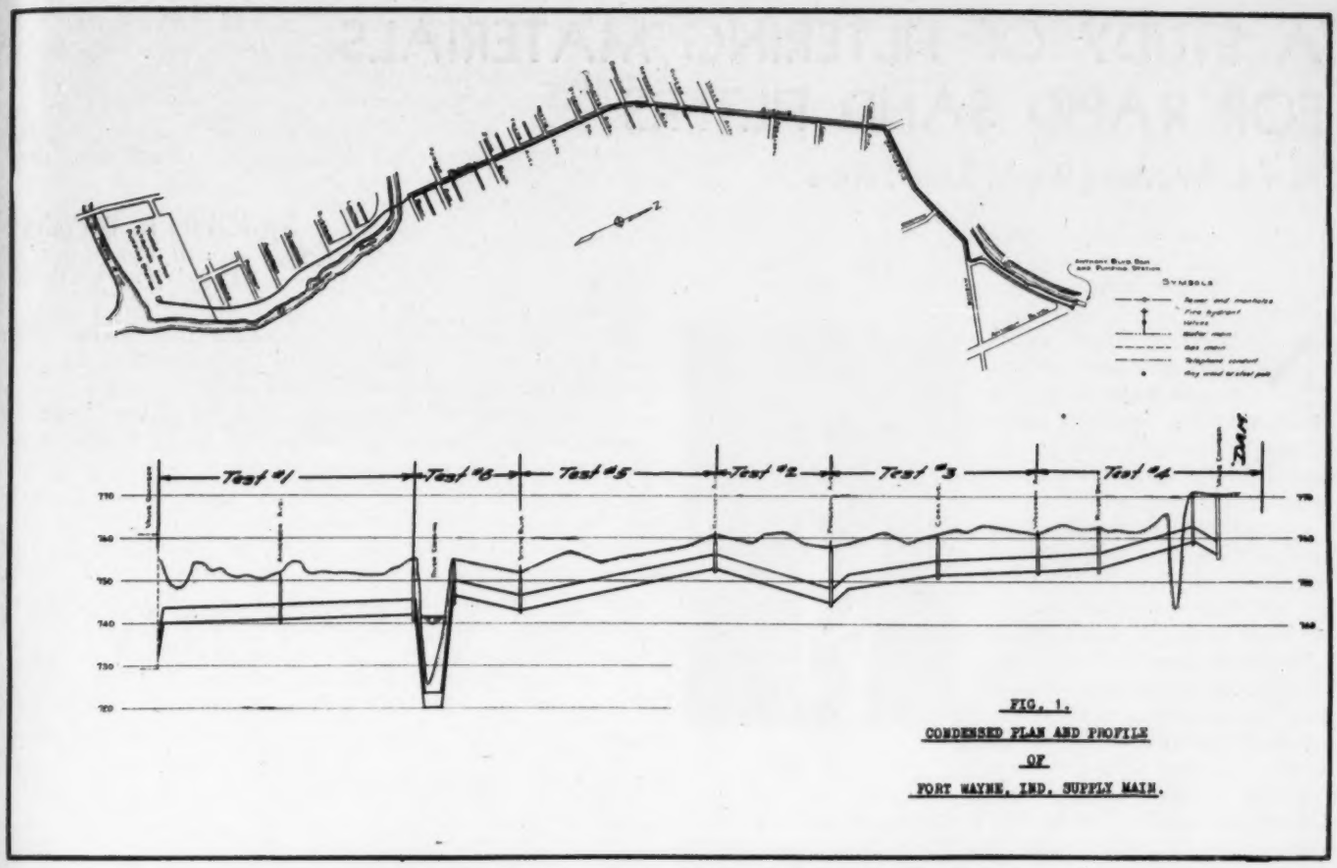



*Fig. 1—Condensed Plant and Profile of Fort Wayne, Ind., Supply Main*

Specifications provided that all pipe for the connections should be of cast-iron with leaded joints, except at valves. The depth of fill over the pipe at the valve chamber was 16 ft. and increased to 30 ft. at the pumphouse. This, and the angle of approach of the 42 in. line, necessitated that the two connecting 36 in. lines should be in cork-screw form, which would have been very difficult to lay and maintain with cast-iron bell and spigot pipe. Accordingly, on application, this fact was realized and the specifications altered by the engineers to permit substitution of ⅜ in. Toncan iron pipe with Dresser couplings for all connections, except at valves and pump house, which remained as flanged connections.

The pipe work was then turned over for execution to the pipe line contractor and involved the furnishing and laying of 180 feet of 36 inch steel pipe specials with five 36 inch Dresser couplings. The installation was quickly and successfully carried out, all special curved sections having been so carefully fabricated that an exact fit was obtained when assembled in place at the site. This installation of the two 36 in. curved lines is pictured in Plate 3, accompanying the first part of this article.

Owing to the amount of curvature and the depth of fill, some form of anchorage was very necessary for these two 36 in. lines. Two concrete supports were located under each of the lines, about midway between the valve chamber and pumphouse and at the pumphouse, and the Dresser couplings were reinforced with ½x3 inch clips welded to the pipe ends back of the joints and connected across with bolts, to prevent the joints from slipping and opening up as the backfill settled. The details of this form of anchorage are also clearly pictured in Plate 3.

All pipe, valves, fittings and connections were left uncovered until after the leakage test. And instead of being tested as a unit, were thrown in with the 42 in. line under Test No. 4 (Table II), which was conducted between a steel bulkhead on one end and a tight 36 in. hydraulic valve in the pumphouse. The rise of the grade in this stretch was such as to afford excellent opportunities for releasing entrained air. Since no leaks were detected in any of the joints in the entire stretch, the result of the test (83.7 per cent under allowable leakage with but a 15 pound pressure drop in six hours), indicates very clearly what effect entrained air can have on such tests and emphasizes the importance of getting rid of it before testing.

## Increase in Length Per Joint

After the line was entirely completed and dewatered, it became a matter of curiosity as to how its length had been affected by both the stops or beads in the center rings of the Dresser couplings and the gaps left between ends of pipe on curved sections made with straight pipe. To settle the question, a stretch averaging about half tangent and half curve and containing approximately 1205 lineal feet of line, was measured with a steel tape, by traversing the inside of the pipe between two manholes. The increased length of line was found to average exactly ¼ inch per coupling or per joint of pipe.

The Fort Wayne line has now been in operation for approximately twelve months, without any leaks or defects appearing. It is considered to be satisfactory, in all respects, by the operating officials of the system. Plant operation at this season is at the rate of 14 million gallons daily, with the peak demand coming between 6:00 and 8:00 P. M., at rate of 32 million gallons per 24 hours.

The writer, who was associated with the contractor, John Denner, Inc., was responsible for working out the pipe line and river crossing details, as well as being in charge of much of the field construction.

# A STUDY OF FILTERING MATERIALS FOR RAPID SAND FILTERS

## Part 4: Washing Rapid Sand Filters

By JOHN R. BAYLIS*
*Physical Chemist Department of Public Works, Chicago*

*John R. Baylis*

NOTHING about rapid sand filtration has received more attention than washing the filter beds. And, probably there is no other factor in filtration practice concerning which there are such wide differences of opinion as that of the best methods of washing. There is not even an agreement as to how clean the sand grains should be kept. Some believed that a gelatinous coating on the sand grains is essential for good filtration, now the necessity of such a coating is being questioned. Many are familiar with developments in washing filters since their first use. The first filter tanks were round and usually were equipped with mechanical rakes to aid in the washing process. With the use of rectangular filters came the air-water wash—the air being used to give more agitation to the sand. Then came the high rate of water wash, and recently a still higher rate of wash is being tried in a few plants.

Numerous efforts have been made to solve the problem of keeping filter beds clean with special types of underdrains, the thought being that the trouble is in the failure of the washing system to evenly distribute the wash water. Uneven distribution of wash water can, of course, add greatly to the trouble, and no doubt is the cause of some of the filter beds getting into worse condition than they otherwise would have with better washing systems. Notwithstanding all efforts which have been made to improve filter washing, we still have not solved the problem of how most simply to keep filter beds in good condition.

It is the purpose of this article to give some observation on the cause of mud ball formation; how the kind and size of filtering materials affect their formation and location in the beds, and the effect of various methods of washing in breaking them up. Mud balls are usually the forerunners of clogged places in the filter bed and, therefore, if their formation can be prevented there will be no clogged areas. The writer has given previous discussions[1] on the formation of clogged areas in filter beds.

*Early Methods of Washing Rapid Sand Filters*—Hazen[2] gives a very good description of the methods of washing rapid sand filters prior to about 1900. At that time filters were constructed by filter manufacturing companies and rate of washing, according to Hazen, was usually from 5 to 7 gallons per square foot per minute. There was very little expansion of the sand bed during the washing process, and Hazen states that the revolving rakes were necessary to prevent the separation of sand into coarser and finer particles. It is now known that the rakes served a more useful purpose—that of preventing the formation of clogged places.

Development and extension of the use of the air-water wash took place between 1900 and about 1915, and while it was not used exclusively for rectangular filter tanks, it is believed that the majority of plants using such filters at that time were equipped for the use of air. Stein[3] states the purpose of the air was to loosen the sand, mix it, and remove dirt by abrasion of the sand particles. Where air was used the rate of applying the wash water was usually between 7 and 10 gallons per square foot per minute. Prevailing practice was to apply the air for about three to five minutes, cut off the air and then apply the wash water. Sometimes the air was applied through a separate system of piping located in the sand bed just above the gravel, and sometimes it was forced through the filter underdrains the same as the wash water.

J. W. Ellms was probably the first to use the high rate of water wash and it was Ellms and Gettrust[4] who made the first thorough study of this method. They referred to a series of tests on various methods of filter washing at Cincinnati made between 1903 and 1905. The methods consisted of forcing wash water up through the bed while stirring the sand with mechanically operated rakes or agitation with compressed air. It was stated by these authors that as a result of preliminary work the high velocity of washing was developed. Since about 1915, nearly all rapid sand filters have been constructed for use of the high rate 24 inch vertical rise of wash, whereas air wash has been provided only to a very limited extent. The practice has been to set the rate of wash at about 15 gallons per square foot per minute, (2.0 feet vertical rise per minute), though there is no definitely fixed rate. The operating staff of the plant usually decide, by trial, the rate which seems to give the best filter wash and the wash valves are set accordingly. In most instances tests on the amount of water applied have not been made, but varies from 12 to 20 gallons per square foot per minute.

*Not Possible to Keep Filter Beds Clean by Conventional Methods of Washing*—The writer has stated,[5] that it is not possible to apply wash water underneath a filter bed in any practical manner which will keep the bed clean. This, of course, applies to sand of the size ordinarily used for rapid sand filters; that is, from .4 to .6 mm. diameter for the effective size. As the rate of wash water is increased and the bed is expanded more and more, a point is soon reached in which the scouring effect produced by the sand grains rubbing each other becomes less. They approach the condition where the grains are merely floating in the water, their downward travel being counteracted by the up-flow velocity of the wash water. Such unusually high rates of washing are of course never used. In a previous article[6] the writer stated he believed that the maximum cleansing effect was produced when the water applied underneath the bed expanded the filtering material about 50 per cent. which corresponded to the rate of washing recommended

*Associate Editor, WATER WORKS AND SEWERAGE.
Note:—This is the 4th of a series of articles. Parts 1, 2 and 3 appeared in issues of Apr., May and October, 1934.

by Hulbert and Herring.[6] Many observations on filter beds have been made since then, and while it is still believed that an expansion of approximately 50 per cent gives about the maximum cleansing force possible to apply to the bed when the water is applied underneath, it has been found that such high rates produce at least one or two detrimental effects. Furthermore, it *does not prevent the formation of mud balls, and falls far short of keeping the beds in as good condition as they should be kept.*

*Surface Wash One Solution*—The evidence is now so positive that a more violent agitation must be used to keep filter beds clean, steps should be taken by those operating filter plants to equip their filters with some more effective washing system. It is not practicable to go back to the mechanical rakes. In fact, it is not believed that the mechanical rakes would keep the filter beds as clean as we should like to have them, and, so far as the writer can see, there is but one solution to the problem. *Some form of a bed surface-wash must be provided.* Such a system is effective if properly constructed and will be explained later in this article. Mud balls must be broken up as soon as they begin to form, if the filter bed is to be kept in the best possible condition and the surface wash serves this purpose.

## Mud Balls

It is worthy of repetition—that the formation of *mud balls* and clogged places in rapid sand filters is *the cause of more filter bed trouble than any other single thing.* The appearance of large clogged places is the result of mud ball formation, and anything which will prevent or quickly break up the mud balls will avoid hard spot formation. The problem then is one of quickly breaking up the layer of coagulated materials and conglomerates which form on the sand surface while the filter is in service.

*Cause of Mud Ball Formation*—Mud balls are formed from the material filtered from the water. The toughest and most compact ones are believed to be formed when the water contains material which clogs the filters rapidly. Among these are microörganisms. However, for most waters, mud balls form to a certain extent at all times and under all conditions. When a filter has been run until the loss of head reaches 8 or 9 feet, a fairly compact layer of the coagulated material is found at the surface of the sand. This layer starts forming as soon as the filter is put into service after washing, and keeps growing in thickness and toughness as the filter continues in use. The layer may break at many points and much of the coagulated material may be drawn beneath the surface of the sand, but almost invariably a surface layer from 1/16 to ⅛ inch or more in thickness will form on all filters. Whenever most of the filtration takes place at the surface the mud balls form more compactly than when there is considerable penetration of the coagulated material into the bed. It is easy to see why this should be the case, for, with little penetration into the sand layer, most of the increase in loss of head takes place at the surface. Should the initial loss of head on the filter bed be 1 foot and the final loss 8 feet, there may be a pressure of nearly 7 feet head of water tending to compact this layer during the latter part of the filter run. This is enough force to materially reduce the water content of the coagulated material and produce conglomerates.

*Observation on the Location of Mud Balls in Filter Beds*—A number of observations, using glass tube filters similar to those pictured in Part 2,* have been made on the effect of the rate of washing on the location of mud balls in the filter beds. The filters had been washed at a rate to produce a 50 per cent expansion of the beds for a period of several months before making observations on the location of the mud balls during the washing periods. Even though the volume of sand was only about one liter in the filters, it was not uncommon to find 150 to 200 mud balls mixed with the sand after a few weeks of such operation. The results of observations on several filters will be given.

Filter JX-3 contained 24 inches of sand from Ottawa, Illinois. The effective size of the sand was .50 mm. and the uniformity coefficient was 54—the size and uniformity coefficient being determined by the new method described in the May, 1934, issue of WATER WORKS & SEWERAGE. The filter had been in constant service about 3 months before the observations were made, and was washed thoroughly at 50 per cent expansion at the end of each run. It was impossible to count accurately the number of mud balls, but fully 150 were present, ranging in size from about ⅛ inch to about ½ inch diameter. When the filter was washed at a very low rate so as to give very little expansion, the mud balls moved to near the surface and distributed themselves in the top 2.5 inches of the bed. Probably the main reason why they extended to a depth of 2.5 inches was because they constituted a large portion of the volume of the material in the top 2.5 inches. Table 1 shows the location of the mud balls for various rates of washing. It will be noted that when the expansion of the bed was 25 per cent or less the mud balls remained near the top of the bed. When the expansion was 35 per cent, some of the mud balls would drop to about 16 inches below the surface. This of course applies to the surface of the expanded sand which was about 8.5 inches higher than the normal surface when the filter is in service. At 50 per cent expansion some of the mud balls extended 30 inches below the top of the expanded bed. This was within 6 inches of the gravel layer. When the bed was washed at a rate that expanded it 60 per cent, the mud balls were distributed from the top to the bottom of the bed, with a larger portion of them being in the lower part of the bed.

Table 2 shows the results of a test on Muscatine, Iowa, sand having an effective size of .49 mm. The results are largely the same as that found for the Ottawa sand, though the mud balls did not extend quite as deep into the bed with a 50 per cent expansion as they did with the Ottawa sand. When the bed was expanded 71 per cent the mud balls were found distributed from top to bottom with perhaps the greatest concentration near the center of the expanded bed.

Table 3 gives the results of tests on crushed quartz having an effective size of .48 mm. The results on this material are very similar to that of the natural sands. Table 4 shows results on crushed glass having an effective size of about .43 mm. It was stated in Part 3 (WATERWORKS AND SEWERAGE, October, 1934) that due to some flat material in the crushed glass the bed did not stratify the same as the other materials. The mud balls had a greater tendency to remain near the surface than was the case for the natural sands and crushed quartz. At a 50 per cent expansion of the bed the mud balls remained in the top 5 inches, but at a still greater expansion some of them lowered themselves deeper into the bed.

The experiments on lighter materials such as crushed anthracite, coal, Minchar and cocoanut char were not exactly the same as for the materials of higher specific gravity. Mud balls were found at almost all depths in these beds during the washing process. Even if the beds were washed at a rate that gave only 20 to 25 per

*WATER WORKS AND SEWERAGE, May, 1934.

cent expansion, the mud balls were rarely observed remaining at the surface of the bed, as was the case for the heavier materials.

*Compactness of Mud Balls*—Attempts have been made to find just how compact the layer which forms at the surface of the filter bed may be, but it is difficult to get exact figures. It is evident that the water has been squeezed out to the extent that the material sticks together. Laboratory experiments on dewatering the sludge from settling basins indicate that there must be less than 80 per cent water content to cause the material to stick together, even loosely. For it to stick together as firmly as it does in some mud balls the amount of water must be less, at least in portions of the mud ball. Table 5 gives analysis of a mud ball taken from a filter which had been in service for some time. This mud ball remained at the surface of the filter bed, even though there was some sand mixed with it. The analysis shows the mud part of the mud ball to have a specific gravity of approximately 1.19. In dewatering the sediment from a settling basin, material having a specific gravity of 1.20 did not adhere together firmly enough to be called a mud ball. This indicates that the material in mud balls of natural formation is not compacted the same throughout the mud ball. It is easy to see that this may be the case, because the material on the lower side of the surface film on filters is more completely dewatered than the fresh material depositing on top of it.

*Washing Does Not Thoroughly Break Up the Surface Layer*—Just before the filter is washed at the completion of a run, the surface is covered with material compacted sufficiently to have some adherence. Usually it adheres together so firmly that the washing does not break it up entirely. Then pieces of the layer remain in the sand bed as small mud balls. If very little sand is mixed with them, they will remain at the surface of the bed to receive more sediment and probably be compacted a little more firmly during the next run on the filter. In most instances sufficient sand becomes entrapped in the mud ball so that after 2 or 3 runs on the filter it causes it to remain beneath the surface of the sand during the washing period, and if it is several inches below the surface when the wash water is cut off, it usually will remain below the surface after the filtering material settles back into place. In a few instances mud balls grows to considerable size. This may take place by one mud ball growing larger or by a mass of mud balls adhering together.

*Specific Gravity of Mud Balls Determines Where They Remain in the Filter Bed.*—For a mud ball to sink beneath the surface of the sand it must have a specific gravity greater than the sand-water mixture at the time of washing. When filter beds are washed by reversing the flow so as to suspend the filtering material, the specific gravity of the material plus water becomes less and less the more the bed is expanded. The specific gravity may be computed by the following equation:

$$(6)\quad S_1 = \frac{(S-1)\ (100-P)}{E} + 100$$

$S_1$ = specific gravity of material and water.
S = specific gravity of filtering material.
P = per cent porosity of the bed of material.
E = ratio of volume of the bed to volume of the expanded bed.

Per cent expansion = 100 E — 100.

The porosity of the expanded bed during washing may vary considerably, depending upon variation in the size of the sand grains. It would require too much space in this article to show the effect of size of sand grains on the expansion of the filter bed, but we know that the top sand is expanded more than that lower in the bed. It would not be correct to state that if the bed was expanded some definite amount that the percentage expansion of the top material will be some definite amount, for all filtering materials do not vary in size in the same ratio. The size ratio may be determined from sieve analysis of a representative portion of the

TABLES 1, 2, 3, 4.—EFFECTS OF THE RATE OF WASH WATER APPLICATION ON THE LOCATION OF MUD BALLS IN FILTER BEDS

| Depth of Expanded Bed Over Original Depth in Inches | Per Cent Expansion of Sand Bed | Rate of Wash Gals. per Sq. Ft. per Minute | Lowest Depth Below Top of Expanded Bed to Which Any of the Mud Balls Penetrated Inches Depth | Per Cent Depth Expanded Bed |
|---|---|---|---|---|
| TABLE 1.—(See Descriptive Footnote) | | | | |
| 2.5 | 10.4 | 7.5 | 2.5 | 9 |
| 5 | 20.8 | 10.5 | 2.5 | 9 |
| 6 | 25.0 | 11.7 | 4 | 13 |
| 8.5 | 35.4 | 15.5 | 16 | 49 |
| 9.5 | 39.6 | 17.4 | 20 | 60 |
| 12 | 50.0 | 19.9 | 30 | 83 |
| 16 | 66.7 | 25.0 | 40 | 100 |
| TABLE 2.—(See Descriptive Footnote) | | | | |
| 1 | 4.2 | 6.5 | 2 | 8 |
| 1.75 | 7.3 | 7.7 | 2.5 | 10 |
| 4 | 16.7 | 10.6 | 2.5 | 9 |
| 5.25 | 21.9 | 13.0 | 3.5 | 12 |
| 7 | 29.1 | 15.3 | 7 | 23 |
| 8 5 | 35.4 | 17.7 | 17 | 41 |
| 12 | 50.0 | 22.7 | 20 | 55 |
| 17 | 70.8 | 27.7 | 41 | 100 |
| TABLE 3.—(See Descriptive Footnote) | | | | |
| 2 | 8.3 | 9.2 | 2 | 8 |
| 3.25 | 13.5 | 10.7 | 2 | 7 |
| 5.5 | 22.9 | 13.8 | 3 | 11 |
| 7 | 29.2 | 16.5 | 7 | 23 |
| 12 | 50.0 | 23.5 | 18 | 50 |
| 19 | 79.2 | 29.7 | 40 | 93 |
| TABLE 4.—(See Descriptive Footnote) | | | | |
| 1.25 | 5.2 | 7.4 | 1 | 4 |
| 3 | 12.5 | 10.4 | 3 | 11 |
| 5.5 | 22.9 | 13.6 | 1.5 | 5 |
| 8.5 | 35.4 | 17.7 | 2 | 6 |
| 12 | 50.0 | 21.2 | 5 | 14 |
| 16 | 66.7 | 26.7 | 13 | 33 |

*Experiment 1—See Table 1 Above*

Glass Tube Filter JX-3 contained 24 inches of Ottawa sand, .50 mm. effective size. The temperature of the wash water was 9 degrees C.

Approximately 150 mud balls were present, ranging in size from ⅛ to ½ inch in diameter.

*Experiment 2—See Table 2 Above*

Glass Tube Filter DX-2 contained 24 inches of Muscatine sand, .49 mm. effective size. The temperature of the wash water was 9 degrees C. Approximately 100 mud balls were present, ranging in size from ⅛ to ½ inch in diameter.

*Experiment 3—See Table 3 Above*

Glass Tube Filter EX-3 contained 24 inches of crushed quartz, .48 mm. effective size.

The temperature of the wash water was 9 degrees C. Approximately 100 mud balls were present, ranging in size from ⅛ to ½ inch in diameter.

*Experiment 4—See Table 4 Above*

Glass Tube Filter Z-4 contained 24 inches of crushed glass, .43 mm. effective size. The temperature of the wash water was 9 degrees C.

Approximately 50 mud balls were present, ranging in size from ⅛ to ⅝ inch in diameter.

TABLE 5.—CHARACTERISTICS OF TYPICAL MUD BALLS AT SURFACE OF FILTER

The filter (No. 4) had been washed at a rate of 15 gallons per square foot per minute for several years. The largest mud balls were about 1 inch in diameter.

| | |
|---|---|
| Weight of mud ball | 13.04 grams |
| Volume of mud ball | 8.82 cc. |
| Specific gravity | 1.48 |
| Weight of sand in mud ball | 4.68 grams |
| Volume of sand in mud ball | 1.77 cc. |
| Volume of mud without sand | 7.05 cc. |
| Weight of mud without sand | 8.36 grams |
| Specific gravity of mud, without sand | 1.19 |

filtering material, and for many materials now in use when the expansion of the entire bed is 30 per cent it will be found that the expansion of the material at the surface will approximate 50 per cent.

Should the mud ball have a specific gravity of 1.20, the equation shows that the per cent expansion required of ordinary filter sand during washing, to cause the mud ball to sink below the surface, will be quite great. When the filtering material has a specific gravity as great as that of silica sand it is evident that there must be some mixture of the material with the mud to cause the mud ball to drop below the surface during the washing period. For lighter material, such as anthracite coal, it is possible for the specific gravity of the mud ball to be great enough to settle below the surface, even though none of the filtering material be mixed with it. If the specific gravity of the filtering material is higher than that of silica sand, there is still less likelihood of the mud ball falling below the surface of the material during washing periods. However, we can always expect some of the filtering material to comprise a part of the mud ball.

*Effect of Sand Mixed with Mud Balls.*—As the specific gravity of silica sand is always very close to 2.65, it is not difficult to calculate how much sand will be required to increase the specific gravity of the mud ball to some definite figure. This may be computed by the equation:

$$(7) \quad S_2 = S_3\,C + S\,(100—C)$$

$S_2$ = specific gravity of mud ball.
$S_3$ = specific gravity of the mud.
$S$ = specific gravity of filtering material.
$C$ = percentage volume of mud in mud ball.
$100—C$ = percentage volume of filtering material in mud ball.

From equation (6) it is easy to calculate that when the percentage expansion of the material at the top of the bed is 50 per cent, that the specific gravity of the mud ball will have to be slightly greater than 1.60 to cause it to settle below the top of the expanded bed during washing. By use of equation (7) the amount of sand required to be mixed with the mud to give a specific gravity in excess of this amount may be computed. Should the mud have a specific gravity of 1.20, slightly less than 30 per cent of the volume of the mud ball will have to be sand. For lighter filtering materials; that is, materials with a specific gravity less than that of sand, the amount required to be mixed with the mud ball to cause it to settle below the surface of the expanded bed during washing is less than that for sand. If the filtering material plus the water within the voids has a specific gravity less than that of mud, any expansion of the bed during washing will cause the mud balls to settle to the bottom of the bed. There is some question therefore concerning the practibility of using very light materials for filter beds.

*Experiments with Artificial Mud Balls.*—Experiments have been made using artificial mud balls. At first the balls were made from a stiff mixture of clay and sand. When made stiff enough they seem to hold together very well, but usually some of the coagulated material which had been filtered from the water would adhere to the surface and this also would cause sand to adhere. As a result there was no assurance that the mud ball was of exactly the same specific gravity as it was when it was first prepared. It was found by coating the mud balls with a thin layer of paraffin that this difficulty could be avoided and that the specific gravity of the mud ball would remain constant. Paraffin coated mud balls of various specific gravities and various sizes were prepared. For balls of low specific gravity a mixture of bentonite and powdered activated carbon was used. By varying the mixture of bentonite and carbon and also by adding varying amounts of sand or other heavy material to the mixture, mud balls of any desired specific gravity could be formed. As the carbon makes the mud balls black they are much easier detected in the filter bed. Materials, such as magnetite, iron ore, which have a specific gravity greater than that of silica sand can be used to make balls of fairly high specific gravity.

The experimental work on the effect of the specific gravity of mud balls in determining their location in the filter bed has not been completed at this writing but their gravities seems to be the controlling factor.

*Results May Be Influenced Slightly by Other Conditions.*—Perhaps when a careful analysis of the experiments has been made some slight influence from other factors will appear. It is probable that the upward velocity of the water may have some influence, especially when the bed is expanded considerably. Since mud balls sink and rise rapidly, a foot or more during washing when they have almost the same specific gravity as that of the expanded bed, this illustrates the possible effect of other influences. Observations on washing filter materials show that the sand is rushing upward at certain points and dropping downward at others. This is due to unevenness in the specific gravity of the expanded material. In portions of the bed the sand gets pushed together a little more than it does at other places. This increases the specific gravity of the mass at that point and causes it to drop downward. When this happens the velocity of water is increased at other points where it is flowing upward, causing greater expansion of the material, and lessening the specific gravity. This produces the boiling effect noticed at numerous points over a filter bed during the washing period. It is natural to expect this to take place, and is why we cannot state definitely at what position a mud ball will be found in the bed after the filter has been washed. When the sand is settling back into place after the wash there is a tendency for the mud balls to rise towards the surface. However, only the small numbers of them near the top ever reach the surface of the bed.

It is not thought that temperature has an appreciable effect, but this cannot be stated positively at the present time. The significant fact is that we find mud balls in filters in which the ratio of the volume of filtering material to that of the total volume of the mud ball varies all the way from a very small percentage up to about 50 per cent. Almost invariably when the percentage of sand is greater than 30, the mud balls will settle into the bed. When it is as great as 40, it is not possible to wash the bed without the mud balls sinking to or near the bottom of the sand bed, even though only 20 to 25 per cent expansion of the bed is produced. To prevent the formation of clogged places, mud balls must be broken up before they are compacted to a specific gravity of about 1.80.

*Mud Balls Do Not Clump Together Badly When They Are Distributed Throughout the Bed.*—Probably the main advantage of the very high rate of wash is that it lessens the tendency of mud balls to clump together in the bed. The small mud balls during high velocity wash appear to remain largely separated from each other and consequently have little tendency for a number of them to agglomerate to form a large mud ball. In the course of time the mud balls are gradually worn smaller by the washings given the filter, and presumably they are eventually washed away or to the surface where they gather more coagulated material and become larger mud balls. If we could be assured that enough sand

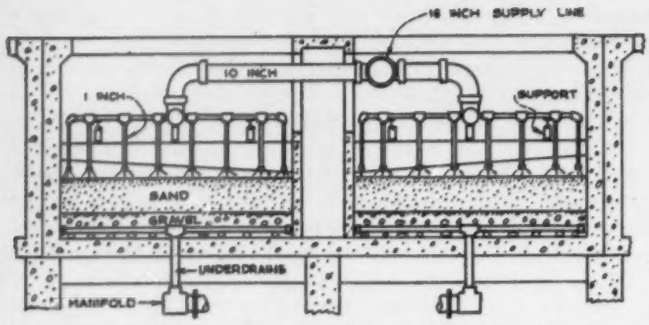



*Fig. 7—Typical Section of Filter with Surface Wash*

would never become encased in the mud balls to cause them to sink to the gravel layer, the very high rate of washing probably would lessen the tendency toward the formation of large clogged areas in the filter. There is an advantage in using a rate of wash which will lessen the tendency for mud balls to clump together, and if no other or a more effective method is going to be devised to keep filter beds clean, then it is advisable to use a 35 to perhaps 50 per cent expansion of the filter bed. Warning should be given, however, that this rate of wash will not prevent the formation of large clogged places in many, if not most filter beds. Furthermore, where this is the case there is great danger of disturbing the gravel layer when employing a very high rate of wash.

The rate of wash necessary to produce an expansion of the bed of 50 per cent usually is so near that which will cause expansion of the top gravel that a little pressure on the gravel from a clogged mass will cause the gravel to move from under the clogged area and form unevenness of the gravel surface with the top of the gravel in places extending up above its original level. This usually causes the wash water to rush upward through the ridged places at a higher rate than at other places, thus helping to produce the boiling effect. Over the clogged areas the sand is rushing downward carrying with it mud balls which are deposited on top of the clogged area. Soon there is a clogged area built up solidly from the bottom to near the top of the sand bed. This form of clogging is particularly troublesome along the side walls of the filter. There is so much danger in the use of rates of washing which will expand the bed in excess of 40 per cent, that such a procedure should be used only where the beds are watched very closely and the clogged areas are dug out as soon as it is known that they have formed.

When the rate of wash is less than 25 per cent the mud balls, as has been stated, will at first remain within the top 2 or 3 inches of the bed, and if they become very numerous, which they do at certain times in most filters, they are so close together they may touch each other. After the filter is put back into service, the pressure on the bed, due to the loss of head increasing, combined with additional coagulating material being deposited around the mud balls, may cause them to agglomerate to form a large mud ball. When the mud balls are formed to considerable size from a combination of a number of smaller mud balls they have considerable sand encased in them, which usually makes them heavy enough to force their way to the gravel surface during the washing period, even though there is not much expansion of the bed.

The writer has observed mud balls several inches in diameter on the surface of filters in two or three filtration plants. Where such large ones form and do not sink down into the bed it is due to the fact that they are built up in a manner which encases very little of the sand; that is, they are not the result of a number of mud balls uniting, but to individual mud balls gradually gathering material and increasing in size. Very large surface mud balls probably are due to lack of properly conditioning the water before it reaches the filters, or to a poor washing system. They are usually found where a large amount of the coagulated material reaches the filters.

## The Surface Wash

The surface-wash scheme involves the installation of a system of pipes located over the sand bed in a manner to project jets of water under considerable pressure into the upper sand bed while it is being washed. Figures 7, 8, 9, 10 illustrate a surface washing system which has given satisfactory results. The surface wash water manifold may be passed along the center of the filter above the wash water troughs with laterals taken off approximately 2 feet apart. The pipes may be supported by the troughs or by supports at the top of the filter tank. At about 2-foot intervals, 1 inch pipes project downward to within 4 inches of the surface of the sand. Caps, preferably of brass, are screwed over the ends of the pipe. The caps are perforated with 3/16 to ¼ inch holes. Four of the holes are made to project the water at an angle of about 35 to 40 degrees to the horizontal, and at right angles to each other. (See Fig. 10.) The 5th hole is in the center so as to project the water vertically downward. If the lateral pipes are 2 feet apart and the downward jetting pipes also are spaced 2 feet apart, this will give 5 jets of water to every 4 square feet of filtering surface.

There may be differences of opinion as to the size and number of holes and the spacing of the jets and the illustrations are offered merely as suggestions of a suitable system. Where there is very little tendency of the water to form mud balls, the surface wash system need not be as elaborate as it should be for some other water which readily forms mud balls. It is evident that the pipes and cap may be smaller than are here shown if there is a high pressure of water, or if the pipes are located closer together. There is some question as to the pressure which should be applied. It should preferably be greater than that ordinarily used for washing filters when the water is applied underneath the filter bed. A pressure gauge connected to one of the laterals should show a pressure of at least 10 pounds. Usually this is greater than the pressure available from the wash water tank, and water from some other source must be arranged for in many instances.

*Amount of Wash Water To Be Applied Through the Surface Wash.*—No definite rule can be set for the amount of water which should be applied through the surface washing system. The rate for some filters may be as low as 2 to 3 gallons per minute per square foot of filtering surface, or it may be as high as 7 to 8 gallons

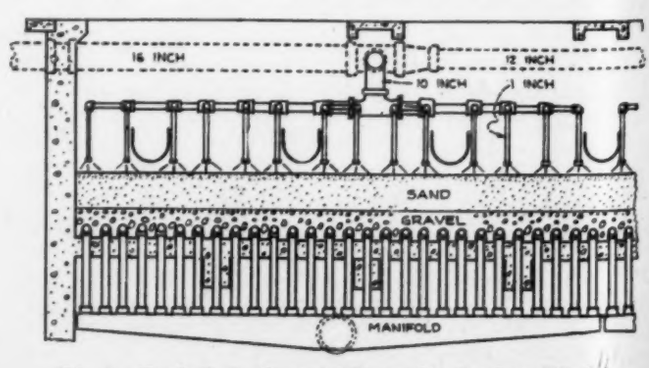



*Fig. 8—Typical Section of Filter with Surface Wash*

for unusual conditions. If there is no knowledge of the amount which should be required, the pipe system and supply arrangements should be made large enough to apply about 8 gallons per square foot per minute. About 5 gallons per minute will be sufficient for most conditions. If it is desired to increase it, drilling the holes slightly larger or increasing the pressure will be satisfactory; but, if it is desired to decrease the amount, new caps will have to be placed over ends of the pipe.

## Summary

Conventional methods of washing rapid sand filters heretofore employed have not kept the beds in satisfactory condition.

An agitating force which will break up all mud balls as soon as they form is essential for keeping the sand beds in good condition.

Mud balls are first formed by the surface layer of mud not being broken up thoroughly during the washing period. Mud balls at the surface of the sand may grow larger by additional mud and floc adhering to the ball. Mud balls beneath the surface grow larger by the agglomeration of two or more mud balls.

Mixture of sand with the mud causes the mud balls to vary widely in specific gravity. Mud balls will remain at or near the surface of the sand bed, or sink into the bed, depending on whether they are lighter or heavier than the surrounding sand and water mixture during washing.

As the expansion of the sand bed is increased during the washing period, the specific gravity of the mass (sand plus water) becomes lighter and will allow mud balls to sink deeper into the bed.

Mud balls of a specific gravity of 1.80 or greater almost invariably will settle to the gravel surface and remain there even with very low rates of wash.

An equation for figuring the specific gravity of suspended filtering materials has been given.

The specific gravity of the compact layer of mud at the surface of the sand appears to be near 1.20 if none of the grains of the filtering material are mixed with the mud.

Mixture of the sand or other filtering materials with the mud increases the specific gravity, and an equation for calculating the specific gravity of various mixtures of the mud and sand is given.

A rate of wash which expands the sand bed 50 per cent causes many of the mud balls to sink to the bottom of the sand bed which otherwise would remain at or near the sand surface. This high rate of wash has the advantage of lessening the tendency of mud balls beneath the sand surface to agglomerate and form larger clogged masses.

The rate of wash necessary to give 50 per cent expansion of the sand will not keep the filter beds in most plants in a condition to be desired. There is no rate of wash which may be wholly applied from beneath the bed which will keep the filter bed in a desirable condition.

The surface wash in conjunction with the conventional up-flow wash, at reasonable rates, appears to be a practical, economical method of keeping filter beds in good condition.

Water under 10 to 15 pounds pressure applied through 3/16 to ¼ inch jet orifices located about 4 inches above the sand surface (when filter is not being washed) to give about 5 gallons of water per square foot per minute will be sufficient for most filters.

The application of wash water beneath the sand in the conventional manner should be enough to give an expansion of about 20 to 30 per cent to the bed at a time when the surface wash is shut off. The combination of both washes usually will require but 12 to 20 gallons per square foot per minute, and this is not so great as to cause loss of sand over the wash-trough edges.

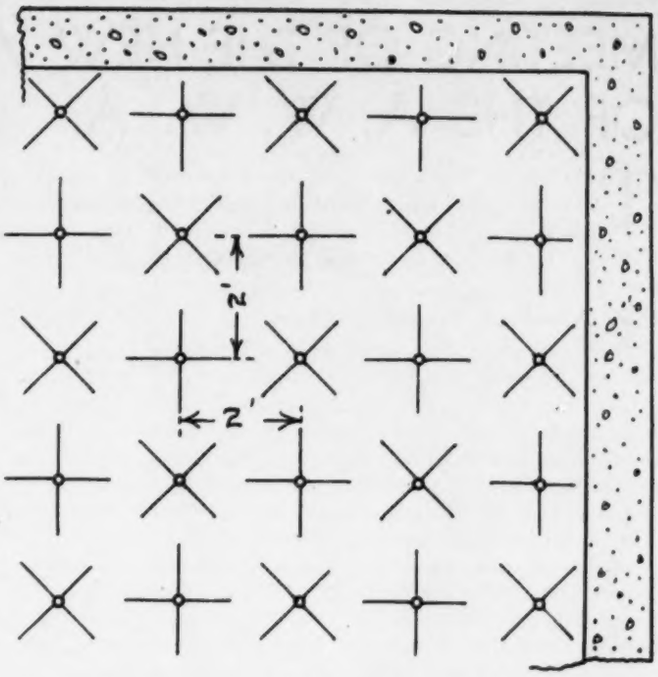



*Fig. 9—Arrangement of Jets in Surface Washing System*

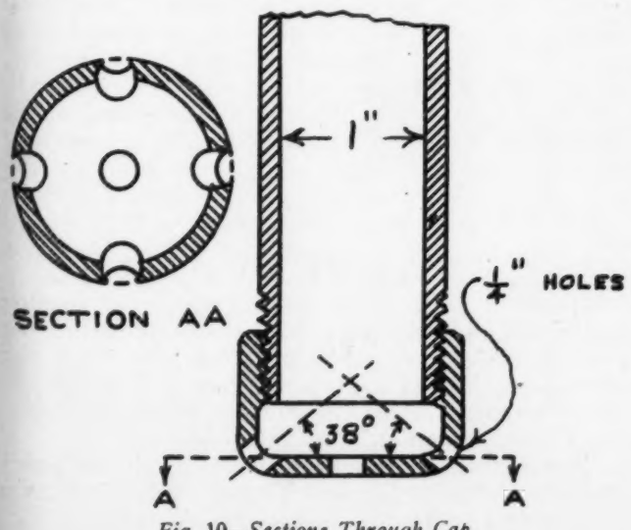



*Fig. 10—Sections Through Cap*

REFERENCES

[1]Baylis, John R. Sand-bed studies at Montebello water filters, Eng. News-Record, 92:516-22, March 27, 1924.

Cracks in filter beds. Water Works and Sewerage, 77:37-40, February, 1930.

Filter bed clogging. Water Works and Sewerage, 77:73-77, March, 1930.

[2]Hazen, Allen. The filtration of public water supplies, Third Edition. John Wiley & Sons, 1908.

[3]Stein, Milton F. Water purification plants and their operation. John Wiley & Sons, 1915.

[4]Ellms, Joseph W., and Gettrust, John S. A study of the behavior of rapid sand filters subjected to the high-velocity method of Washington. Trans. Am. Society of Civil Engineers, 80:1342-1428. 1916.

[5]Baylis, John R. Washing rates for rapid sand filter beds. Water Works and Sewerage, 77:123-125, April, 1930.

[6]Hulbert, Roberts, and Herring, Frank W. Studies on the washing of rapid filters. Jour. Am. Water Works Association, 21:1445-1513, November, 1929.

[7]Baylis, John R. A study of filtering methods for rapid filters. Part I. Water Works and Sewerage, 81:127-130. April 1934; Part 2. New method of determining effective size of sand. Water Works and Sewerage, 81:162-168, May, 1934; Part 3. Testing various filtering materials. Water Works and Sewerage, 81:352-357. October, 1934.

# MEETING OF THE NEW YORK STATE SECTION OF THE A. W. W. A.

THE New York Section of the American Water Works Association held its mid-winter luncheon meeting at the Hotel New Yorker in New York City on December 28th—the attendance being 125 or thereabouts.

## P.W.A.—Past, Present, Future

Past-President Malcolmn Pirnie spoke on the matter of the probable further extension of the P.W.A. program of public-works construction as a measure of industrial recovery. He reported that there was little doubt but that the program would be continued in one or another form. Just how extensive or exactly what plan would be followed was still an open question. There appeared to be four to five million able bodied unemployed which could be partially absorbed on public-works projects. The P.W.A. method of financing and procedure had been far too slow and encumbered and thereby failed as the practical, prompt and sizeable unemployment relief scheme that was contemplated. The C.W.A. program resorted to last winter had filled the need far better and something similar could be looked for again shortly.

Reviewing the status of the P.W.A. program* as of November 1st, 1934, Mr. Pirnie said that 2,878 water and 896 sewerage projects had been approved. The total allocations of $1,019,000,000 was made up of $556,000,000 for water works and $464,000,000 for sewerage betterments. Completed projects numbered 453 ($525,000,000) and 417 ($442,000,000) were now under construction.

Mr. Pirnie told of the affiliation of the Association with the Construction League which had drawn up certain policies and recommendations for a program which would be sponsored by the construction industry. These included the recommendation that the wage scale on Federal Aid projects should be the same as that locally prevailing, rather than a uniform wage rate previously set for the whole country. That, laws should be enacted (where now non-existant), to make legal the issuance of revenue bonds for financing self-supporting public utility projects. That in normal times some sort of pay-as-you-go plan should be adhered to in constructing public works, thus reducing the high cost in interest charges and a pyramiding debt. That advanced planning of public works be practiced universally, in order to be prepared to proceed quickly with construction when a future emergency arises requiring unemployment relief.

COLONEL CHEVALIER, in discussing the subject, felt that already there had been too much of a tendency to confuse the *business* of public works construction, and its natural employment *at fair wages*, with the relief dole idea. He vehimently denounced the proposal of the nation's manufacturers who had recently suggested a public-works program which would employ men at bare subsistence wages.

EARLE DEVENDORF, Engineer of the State Department of Health, reported on public-works construction progress in New York state which had its fair share of 139 sewerage and 135 water works projects.

## Technical Papers

**"Cold Weather Problems and How to Meet Them"** was the subject of an impromptu talk by W. A. McCAFFERY, Supt. of Water Works, Oswego, New York, who reported on the difficulties encountered last winter in Oswego—not the least being that of freezing up of the supply intake line from the lake.

Frost had penetrated the ground 58 inches and during one period of two weeks they had had to thaw out 1,800 services, using transformer equipment and three electric welding machines operated by power company personnel. Failure to break the service connection entering one building, before furring through the current had resulted in a fire due to overheating of house wiring. Main thawing was followed by many and serious leaks due to pipe breakage. This had necessitated laying of much new main immediately. The use of electric welding machines had proved the most successful and practical of all schemes and recently improved equipment, designed more especially for electrical thawing, had become available for use in future thawing. In reply to a question, Mr. McCaffery said that 200 amperes at 8 volts had seemed the most effective and safe current to put through from a D.C. generating set for thawing services.

**"Asbestos-Cement Pipe and its Application"** was the subject presented by C. A. MCGINNIS, Engineer, Transite Pipe Department, Johns-Manville Corp., New York City, who explained, by the use of moving pictures, the fabrication and laying of "Transite" pipe.

Mr. McGinnis said that 9 foreign plants and one American plant were now producing asbestos-cement pipe in sizes of 2 to 32 inches in 10 and 13 ft. lengths, to meet A.W.W.A. specifications for various classes of pipe from 100 to 500 ft. heads. The pipe was produced by mixing 15 per cent fibrous asbestos with 85 per cent cement, thereafter making this mixture into sheets by a process very similar to paper board manufacture. The wet sheet (0.01 inch thickness) by continuous winding around a steel pipe-forming mandrel, as it left the felts of the transite fabric-making machine, formed the laminated pipe structure. Later a pressure of 2,000 lbs. per square inch consolidated the laminations to the dense pipe structure. Pictures of a recent installation of distributing and supply mains (11,000 ft. Class C pipe) at New Hartford, N. Y., were shown to reveal laying, handling and jointing operations. At Conastota, N. Y., and Ordway, Colo. (other recent installations), were also pictured. Also fittings and valve insertions, corporation-cock tapping operations and joint making were pictured.

WM. T. FIELD, Consulting Engineer, Watertown, N. Y., being responsible for the selection of Transite pipe for the Hartford installation, commented on the characterists of the pipe which had cost 20 per cent more than Cast Iron pipe, weighed 33 per cent less. In reply to a question, he could not report leakage figures because tests had not been made to date.

ALEXANDER POTTER, Consulting Engineer, New York City, reported on experiences with this type of pipe in Cuba, where, at the time, the installation of standard fittings had been difficult. Mr. McGinnis replied that in the U. S. A. Standard B. & S. Cast Iron fittings and valves were jointed with joint compound in the customary manner. Abroad 8,000 miles of asbestos-cement pipe (Italian invention) had been laid.

The paper scheduled to be read by O. C. Butler, Superintendent of Public Service, Niagara Falls, N. Y., was not presented because of the author's absence.

*NOTE—P.W.A. Release No. 1000 constitutes a review of the nature and status of all P.W.A. projects to November 1, 1934.—*Editor.*

*General View of the New Plant Showing What Can Be Accomplished at Little Expense. Visitors Are Welcome, Especially Those Who May Be Interested in Contributing Shrubs and Plants*

# BENEFITS RESULTING FROM PLANT BEAUTIFICATION

By EDWARD H. RUEHL*

*Water Works Engineer, Roanoke, Va*

*E. H. Ruehl*

WHEN visiting around at different water works and sewerage plants it is very noticeable how few of the officials in charge really make any determined effort to beautify the plants and grounds. In a good many cases such beautification would cost very little indeed, in fact, the operator of the plant could do a great deal in this direction in different odd moments. Judging from my own experience, they would get much real satisfaction therefrom.

Beautification of this sort is justified and gratification is gotten when visitors compliment the operators rather than make no mention of the appearance of the plant and are actually not impressed, which is the case when plants and grounds are not made attractive or are kept in a not too neat manner.

Bluefield, Virginia, has had the experience of having both types of plants, one that was very untidy and another one on which an effort was made to keep the plant in a clean presentable manner at all times. So, with pardonable pride I hope, certain things that were done to beautify the new filter plant will be mentioned; and, these things, or ones similar thereto, can be done around practically any water works property or sewage treatment plant. The sole thought in my mind, however, is to stimulate more interest on the part of the public as well as the operators in the beautification of plants, especially the smaller ones where the need thereof seems to be the greatest.

Bluefield, for many years, had an old pump house constructed of corrugated iron and situated in a very small lot enclosed with an old time rail fence, over which one had to climb to get to the building. The operator of this plant attended to his duties but showed very little interest in the work and between times would sit down on a board in the front door and whittle.

The people who passed by (there being no visitors at the place) would wonder what it was and that was about all. Ladies never thought of visiting the plant and, even if they did have any desire to, would have have had to climb the rails to get in. A picture of this old pumping station is shown herewith.

During the year 1931 the Town of Bluefield constructed a modern filter plant and pumping station. The town officials, looking toward the future, acquired two acres of land along the Bluestone River for a plant site and approximately one-half acre immediately adjacent

*Former Town Manager and Engineer of Bluefield, Virginia.

*Bluefield's Municipal Water Works—BTM*, with Which the Editor of* WATER WORKS AND SEWERAGE, *While Sanitary Engineer with the Virginia State Department of Health, Was Not Unfamiliar. The Superintendent, Chief Engineer and Registrar Was Then Also the Town Sergeant.*

*Before Town Managership.

and upstream from the plant. Thereby the town is assured of a plentiful supply of water for many years to come and the land was purchased looking toward the beautification of the area as a small park.

This plant site is about two miles from town and was partly under cultivation and partly nothing but a rough, swampy river bank. Across the river is a tract of wooded land, which is not owned by the town but adds to the general setting.

When the construction of the plant was completed there was all kinds of debris left about the premises as well as a number of holes filled with trash, old automobile fenders, tires, old fence wire and what not. The material removed from the excavation of the clear water reservoir, coagulation basin and filter house was piled up at different places and in general the place looked almost hopeless, which is usually the case when the construction work on any project is just completed.

Before much had been done toward cleaning up the place a very heavy rain fell and the river swelled out of its banks, the water getting up to the filter building door. A hurry call brought the writer to the scene with a truck load of men, sacks, boots and other equipment thought necessary to prevent the flooding of the plant. This proved unnecessary, however, but a view of the site under this condition caused some slight changes in the layout of the grounds.

## First Steps in Beautification

Previous to this, there was sketched on one of the blueprints of the general layout of the plant an entrance roadway, and other ideas in the way of landscaping that could be sketched thereon. In other words, a rough plan of beautification was indicated and it served its purpose well.

As the clear water reservoir was circular, about forty feet in diameter, and sufficiently distant from other parts of the plant a nine foot roadway around it provided a very good place for the general visitor to the plant to turn around and the entrance roadway was planned with this in mind. To prevent the fenders of the cars from scraping against the overhanging top of the clear water reservoir a row of rocks was placed concentrically around the body of the reservoir about one foot away. The space between this rock curb and the reservoir made an ideal space, after being filled in with top soil, for a rock garden, which was started with a number of hen-and-chicken plants that were donated by friends. This was the start in the direction of securing many other donations of plants.

Where the road around the circular clear water reservoir joined the entrance road there was formed a small triangular space which was also converted into a rock garden, with a rock flag pole base erected therein. These are clearly shown on one of the accompanying pictures.

It might seem strange to spend any time writing about rough old rocks, but some of the rocks used in these rock gardens about the plant proved very interesting to so many citizens that mention will be made of them.

As the river just below the plant was being cleaned out for the sake of general appearances (afterward used by children as a wading pool), certain limestone rocks that had been eroded into very grotesque shapes were selected and used to make the rock gardens. Some of these rocks created so much interest that visitors to the plant wanted to take some of them home for their own gardens. We traded rocks for shrubbery and plants.

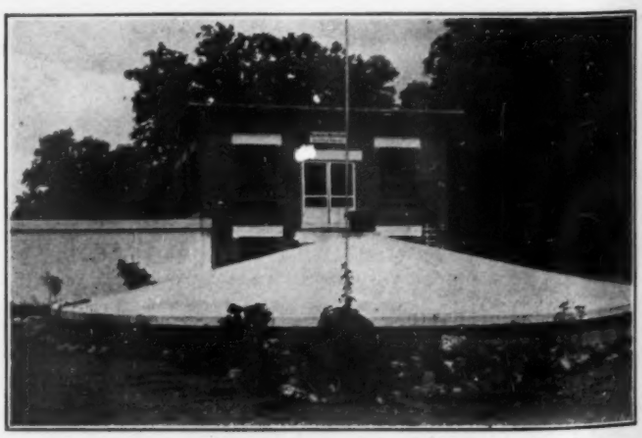
At the rear of the plant there were some old sycamores, willows and walnut trees, and to the side some thorn bushes. These were all trimmed up and flower beds made beneath and the appearance greatly changed for the better. In selected places, with due regard for falling leaves, future plant development and other considerations, native maple, pine, dogwood and crabapple trees were planted, although some of them died there were always plenty more in the woods in the vicinity of the plant for use in replacements and additions. For practical and economic reasons we decided to stick to native trees and shrubbery as much as possible.

Grass and short clover seed was sown where needed, there being certain stretches already covered with natural grass which were cleared off and taken care of.

## Cooperation by Citizens

As the citizens of the town learned of the improvements being made at the plant they started to send all kinds of flower seeds, slips, shrubs, bushes and small trees. The ball had started rolling. One resident took so much interest in the plant that he sent about two bushels of iris bulbs, all separated out as to blooming dates and catalogued with complete instructions as to planting. Needless to say, there are plenty of iris about the plant and these are hardy and decorative plants which can be highly recommended.

The change in the morale and ambition of the op-



*The Clear Water Reservoir Encircled by an Interesting Rock Garden. Trailing Virginia Creeper and Ivy Will Eventually Cover This Structure*

*The Backyard of the Plant. A Flagstone Walk, Blue Grass and Rough Stone Benches, Beneath an Old Apple Tree. The Old Oxen Yoke Hung from the Near Limb Adds Its Bit to the General Effect of the Parked Area*

erator, the same one who had previously whittled in his spare time) was very noticeable. And, to see him grubbing briars and old roots was an inspiration. When the writer took a lawn mower to the plant and told the operator to start cutting the original grass along the river he was met with a look of disgust, but constant application of the mower caused a very fine stand of grass to develop and on walking over the velvety grass about a year later the operator mentioned that "he had thought the writer was a fit subject for the lunatic asylum when he brought a lawn mower to the plant and told him to mow the grass." Anyway, the cutting was continued and the writer was vindicated as to his claim to sanity.

## Visitors and Publicity Grew With the Plants

As time went on the grass, trees, bushes and flowers all grew and with them the number of visitors to the plant, all with some word of commendation.

The effort toward beautification was not lessened and gradually old mill-wheels were acquired and along with natural stone slabs these were made into benches under the trees. Bird houses were built in the trees and on poles, with vines started up these poles. An old ox-yoke and ox shoes were acquired and hung in a conspicuous place, trellises for roses were made and a rustic sign with the wording "Water Works Park" was hung.

All these little things, costing practically nothing, caused considerable interest and news articles such as the one from which the following is quoted:

"While traveling for miles in search of a beauty spot during the hot weather, most of our people are overlooking about the loveliest place in Tazewell county right at home. Have you visited the beautiful park at the filtration plant on Hockman pike? Just now the premises are resonant with the fragrance of the rambling rose and other flowers.

"Spreading trees shed their protection over the spot from the sun, while wild vines vie in climbing stately oaks as hundreds of birds engage in their daily serenades. Then Bluestone river lazily rolls down over the shoals after finding its way under an old-fashioned water gap.

"The filtration plant itself is worth seeing, with the churning water, tanks, pipes and corkscrew stairway. It is about one mile south of the city limits on the Hockman pike. The park is owned by the city."—Bluefield Daily Telegraph.

The result was a steady stream of visitors to the plant and on many days there were from twenty to fifty visitors. On one Sunday there were over two hundred, some coming from many miles distant.

Imagine how the operator of this plant felt when he received a letter from a certain group of young church people, who had held an open air meeting in the park, thanking him for the courtesies extended and mentioning how the quiet peaceful surrounding had added a great deal to the meeting.

What a difference from the old plant that people just passed by and said, "Oh, that's just the water works."

When the extremely small cost of beautification is taken thought of it is a wonder that more of our plants are not dressed up more. It would not be amiss to suggest that in the case of new plants certain phases of this planning be done at the time of getting up the plans and specifications for the plant and that the painting of the interior walls with neat attractive color combinations in harmony with the equipment be given attention.

Screens and screen doors should always be provided to keep out the myriad of insects and moths that make things so unsightly, either alive or dead.

It is not to be construed in any way that it is meant for the operator of a plant to neglect any of his regular duties in connection with the operation of his plant as this is his first consideration, but there are odd moments, depending of course on the particular plant, when much work can be done on the grounds. Nothing inside the plant at Bluefield, Virginia, has been neglected or slighted and all equipment was kept up, machinery and building touched up with paint from time to time and the brass polished up. The quality of the water was always the first consideration.

### Raising the Standard of the Waterworks Operator

The operator of a plant, where things are kept up and beautified, has much more interest in his work and it is natural that he feels better when the citizenry pass compliments when visiting the plant. And, if his superiors would instigate and plan such improvements there are, no doubt, many operators who would be more than glad to spend their spare time in such a recognized way as beautification has proven to be at Bluefield.

Naturally there are things to be guarded against. From the start there is a demand from the various churches and organizations to have picnics on such grounds, but in the writer's opinion this should not be permitted as too much damage is so easily done and as a rule there is always some litter left. Visitors and small groups should, however, always be welcome and should be extended all courtesies.

Bluefield, Virginia, has found that the thought, effort and small expense incurred in beautifying its filter plant and grounds has been justified and although it has no direct bearing on the quality of the water there is a certain psychology that tends to make people feel safer when drinking water from a plant well taken care of inside and out. Furthermore, the price paid for the product or service does not seem as high to the citizen who has visited the properties of a well kept and attractive plant, manned by courteous operators.

▼

## Old Standpipe Rehabilitated by Guniting—$4,000 Spent—$14,000 Saved

By V. VON GEMMINGEN

*Town Manager, Culpeper, Va.*

During the year 1895 the town authorities of Culpeper, Va., had erected a standpipe of 300,000 gals. capacity. Since its erection, it has probably had no more maintenance work done on it, so I am informed, than the application of two coats of red-lead paint during its 38 years of service. It had gotten into such a weakened condition from corrosion that for a time it appeared as if it would have to be replaced by a new tank or reservoir and, thereafter, removed at an expense in addition to the expense incurred in providing new service storage.

After giving the matter of possible renovation of this old structure, by application of a jacket of cement mortar from a gun—"Guniting"—some study, it was estimated that the project would cost $4,000 or thereabouts. There was a large difference between that figure and the estimated $18,000 or more which it would have cost to provide a new tank or reservoir. It was decided to proceed with the project of Guniting the standpipe and its base, for which authorization was given by the Town Council to spend up to $4,000.

### Procedure Followed

The successful bidder for the work of "Guniting" the structure, according to specifications, was the National Gunite Company.

First, the town laid a heavy false bottom in the standpipe consisting of a reinforced concrete slab. The contractor came in and cleaned the inside walls of the structure and welded the necessary reinforcing and holding wire to its sides. "Gunite" was then applied, starting with a thickness of 2.5 inches at the bottom and running out to 1.5 inches at the top. On top of this a second or seal-coat was applied and in three days water was turned back into the standpipe.

The structure has shown no signs of leakage, whereas, prior to its renovation, there were approximately 50 active leaks in the side walls, and in one spot a hole about half the diameter of a lead pencil had been eaten through the iron plate.

The standpipe rests on a rubble masonry base from which much of the cement mortar had disintegrated. This unsightly, and probably dangerous, foundation structure was also "Gunited" to produce a sightly and strong structure.

The 39 year old standpipe, which a year ago was ready to be junked as worthless, is today as serviceable as when new and apparently good for another 30 years if not longer. We feel that we have made an excellent investment in having spent $4,000 and thereby avoided an expenditure of at least $18,000—a net saving of $14,000. The "Guniting" job has been in every respect satisfactory and we are highly pleased with the results.

▼

### Garbage Disposal Via Sewage Treatment Works

Baltimore, Md., in 1933 disposed of a fair portion of its summer garbage by grinding it and discharging the pulped material to sewers. Preliminary studies had indicated that garbage may be settled out and readily digested at 28° C. along with sewage solids within a period of 30 to 40 days to produce 600 to 700 c.c. total gas (50 per cent Methane) per gram of dry volatile garbage solids. The optimum pH for digestion proved to be 6.8 to 7.2. A Jeffrey Shredder was employed to macerate the garbage at a rate of 20 tons per hour.—1933 Annual Report, Maryland State Department of Health, Division of Sanitary Engineering.

▼

### Copper and Brass Research Association to Expand Activities

At the recent reorganization meeting of the Copper and Brass Research Association the mining companies withdrew. The fabricating members, however, have formulated plans to continue and expand the Association's activities under the leadership of F. S. Chase, President of the Chase Brass and Copper Company, as president of the Association. John A. Coe, President, American Brass Company; C. D. Dallas, President, Revere Copper and Brass, Inc.; Wylie Brown, President, Phelps Dodge Copper Products Corp., were elected Vice-Presidents. B. B. Caddle was named Secretary of the association with offices continued at 25 Broadway, New York City.

# EDITORIALS

## Has P.W.A. Been Worth While?

WITH the close of 1934 it is fitting to look back and ask: What has been accomplished by the Public Works Administration in the way of waterworks and sewerage betterments.

During the year just ended much criticism was heard of PWA and its methods, its slowness and cumbersomeness due to red-tape practices. Many early in the year voiced the opinion that the PWA program had actually retarded progress in new construction of water works and sewerage projects in several instances. There was considerable, perhaps justified, criticism of the slowness of PWA in passing on the legality of proposed municipal projects and the security offered PWA. A proper question then to ask, is: Has PWA been really worth while?

To answer these two questions statistics are available, as of December 1st, 1934, which reveal a total allotment of loan and/or grant money by PWA amounting to $257,045,728 on 1621 non-Federal water works and sewerage projects. Of extraordinary interest is the fact that 722—almost half—of these project allotments have been for the installation of "complete water works systems" mostly in small towns previously without public water supply systems.

Worthy of note, is the following recapitulation of non-Federal water works and sewerage projects financed by PWA which have been completed or are now under construction:

| | Projects | Allotments |
|---|---|---|
| **Water Works** (totals) | **976** | **$ 90,004,722** |
| Water Mains | 125 | 10,715,897 |
| Reservoirs—Tanks | 89 | 9,650,200 |
| Filtration Plants | 40 | 7,018,200 |
| Complete Water Works | 722 | 62,620,475 |
| **Sewerage** (totals) | **584** | **$162,174,056** |
| Sanitary Sewers | 323 | 112,874,358 |
| Storm Sewers | 64 | 9,648,720 |
| Combined Sewers | 59 | 8,553,783 |
| Sewage Treatment Plants | 138 | 31,097,195 |
| **Water works and Sewerage** (jointly) | **61** | **$ 4,866,900** |

The $257,045,728, expended to Dec. 1st for water works and sewerage betterments, represents 33 per cent of the total of all allotments made to non-Federal bodies for all forms of public works projects.

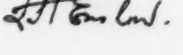
Indicative of progress, 177 projects under construction November 1st, were completed by December 22nd, raising the total completed in 1934 to 630. Between these same dates 301 additional projects (not included in the above listings) were put under construction, thus raising the number of projects under construction as of December 22nd to a total of 1602.

Although there was heart breaking slowness in getting PWA projects under way in 1933, the ball got to rolling in good fashion before the end of the past year. The above figures are impressive to say the least. It will surprise many to learn that during 11 months of 1934 contracts let for PWA projects of water works construction exceeded in value those of 1929 and 1930 (the big construction years) by 50 per cent; those for 1932 by better than 100 per cent. Considering that it took almost 6 months for 1933 to get organized and functioning properly, progress made to date by PWA is the more impressive. Added to the causes of delay in getting water and sewage projects under way, were debit limitations and statutory regulations which prevented many municipalities from legally issuing bonds without a bond election, if at all. Further, the lack of adequate plans, on which PWA engineers could pass judgment as to soundness of projects, was in too numerous instances an added cause of delay. These two handicaps combined to prevent PWA construction getting underway in any appreciable volume by late 1933 and was the principal cause of the necessity of establishing its offspring, the Civil Works Administration, which financed ready-to-go projects with less regard as to their legality or proven need. CWA was responsible for getting many worthy projects (many switched from PWA) under way and completed quickly, none of these have been recorded in the above PWA figures. Many advocate a system patterned after that of CWA, as being the most practical of the two for speeding public-works construction and eliminating red tape in future programs.

The greatest single aid in getting public utility projects financed by PWA or through private sources, and quickly under way, were the legislative acts put through in 29 states as emergency measures to legalize the issuing of the revenue type of bond by municipalities or counties to finance self-supporting water works and sewerage systems. In all there are now 32 states in which the revenue type of bond is legal. Courts have tested these acts and they have been sustained. The importance of this measure is thoroughly emphasized by President Roosevelt in his very recent letter to the Governors of all States in which he urged every State Administration, not now among the 32, to take immediate steps to legalize the issuance of revenue bonds by its political subdivisions, in order that benefits from a proposed future public works program for 1935 could be quickly taken advantage of. The President in the same letter also urged simplification of procedure for authorization and financing, by municipalities, of public-works projects; the elimination of requirements of bond elections for the period of emergency; the creation of municipal improvement authorities with power to issue bonds of the revenue type, without election, for financing utilities; the relaxing of statuary limitations upon taxing power to pay debts.

Following closely upon this letter, the President on January 4th called on the Congress to put a very large scale public-works construction program on its calendar as the No. 1 item. It is the plan of the Administration to materially extend the present public works program with certain needed revisions which experiences have dictated. With machinery well-oiled, the promptness of execution will be assured in the geared up operation of PWA which has for some months been getting its decks cleared and equipment in order to handle the new program. Because of their self-supporting nature, water and sewage projects, in the words of President Roosevelt, will be given right of way. Many projects are ready to go and many others should be lined up promptly.

Admittedly disappointing at first to the President, as the rapid reemployment measure that it was expected to be, the ultimate value and soundness of his public-works program has so impressed itself on the Administration and its advisors that Mr. Roosevelt's decision to extend and enlarge the program is in itself a sufficient answer to the question: Has PWA been worth while?



# NEW EQUIPMENT AND LITERATURE

## A Review of Catalogs and Trade Literature Received

*Columbian Shear and Sluice Gates, Mud and Flap Valves, Low Pressure Gate Valves*—A bulletin describing new Columbian equipment, especially adaptable for sewage treatment works and sewage systems generally. Company long in the water supply field—now a division of Mueller Company. Ask for Bulletin S-1 Columbian Iron Works, Chattanooga, Tenn.

*"Duroline Pipe"*—In a recent bulletin the history of cement lined pipe is told by National Tube Company of Pittsburgh, Pa., developers of the highly resistant cement lining used in various sizes of Duroline Pipe now extensively employed in industrial plants where corrosion is a problem. Illustrations show cement lined pipe after 58 years of service in New England and a table of friction coefficients and specifications of Duroline Pipe and fittings ½ to 12-inch diameter is included. All interested in low solubility cement lined pipe for industrial or house service lines and mains should request Bulletin No. 28 from National Pipe Company, Pittsburgh, Pa.

*"Are You One of the 80 Per Cent?"*—Is the question asked by Electro Bleaching Gas Co. (the pioneer producer of liquid chlorine in America) as the cover title of a recent leaflet dealing with the production of and the need for high purity liquid chlorine in the water works and sewerage field. In a companion mailing piece, "E. B. G." presents *"Important Facts About Liquid Chlorine"* for water and sewage works operators. For both—address Electro Bleaching Gas Co., 9 East 41st St., New York City.

*"Taste and Odor Control"*—Issued monthly by Industrial Chemical Sales Co., manufacturers of "Nuchar" carbon, is a journalette. The special Christmas issue recently distributed is profusely and interestingly illustrated, carries no advertising. Previous volumes have carried newsy stories of Nuchar application. A distinctive feature is the section by "F. E. S.," recounting a variety of practical suggestions in water works operation which is headed "Seen and Heard in the Field." Prepared for free monthly distribution a subscription costs only the asking but is worth much more. Address Industrial Chemical Sales Company, New York Central Building, New York City.

*Modern Elevated Tanks*—A new illustrated catalog of R. D. Cole Co. (Est. 1854) pictures many styles of tanks, special and ornamental designs, elevated and ground storage of various capacities. Request "Tank Talk" from R. D. Cole Manufacturing Company, Newnan, Ga.

*"Ferrisul"*—Anhydrous ferric sulphate, manufactured and sold as "Ferrisul" by Merrimac Chemical Company of Boston, Mass., is described. Also many useful facts concerning this dry ferric iron coagulant are set forth in this new folder issued by the manufacturer. Anyone interested in the improved ferric coagulants for water and sewage treatment would do well to request a copy of "Ferrisul" from Merrimac Chemical Co., Everett Station, Boston, Mass.

## Chain-Link Fencing of Copper-Bearing Steel

It is becoming increasingly important to adequately fence in reservoirs, and other water works properties; more so, to enclose sewage treatment works, pumping stations, etc., where constant attendance is not maintained.

Chain-Link Pittsburgh Fencing of copper bearing steel galvanized by hot zinc dip after fabrication (A.S.T.M. Specifications), manufactured by Pittsburgh Steel Company, is here illustrated. Posts

*Reservoir Enclosure*

and rails are of the smooth, extra strength seamless steel tubing which is heavily galvanized and to which the fence fabric is tied with non-corrosive snug-fitting tie-wires made of high tensile aluminum.

Pittsburgh makes a specialty of slide-gates in addition to the conventional swing-gates. Gates and many styles of fences are attractively illustrated in their very complete "Chain Link Fence Catalog No. 322-B." For a copy, write Pittsburgh Steel Co., Pittsburgh, Pa.

▼

## Unique Vibratory Chemical Feeder

Feeding dry chemicals from a *vibrating* feeder is novel in the water works and sewerage field. The recently announced feeder here illustrated is built by Syntron Company of Pittsburgh, Pa., specialists in the manufacture of electro-magnetic vibrators and hammers. It consists of a non-arching vibrating hopper and vibrating feed trough—the vibration of amplitude of vibration crating, at will, a rapid flow or a slow "creeping" of the lime, alum, sulphate of iron, etc., through the feeder trough.

The vibratory pulsations actually cause the chemical to "flow" up-hill through a tube or trough (see cut). All orifice controls or speed changes, commonly employed in variable feed mechanisms, have been eliminated. A turn of a rheostat dial regulates the feeder output electrically by changing the intensity of vibra-

*Syntron Feeder*

tions and thereafter maintaining a constant rate or amplitude of feed trough vibration. Arching in the hopper is prevented and constant flow insured by the separate hopper-vibrator which ceaselessly "taps" down the chemical in the conical hopper.

The elimination of moving and wearing parts, orifices that become clogged, motors, bearings, and the like would appear to be the major advantage of the Syntron feeder. The feed capacity, according to guarantees, may be varied from 2 ounces to 2000 pounds of chemical per hour, with a current consumption of but 200 watts per hour.

A catalog and more complete information on this novel and trouble-proof feeder can be had by addressing Syntron Co., 400 No. Lexington Ave., Pittsburgh, Pa.

▼

## P. J. McGuire Made Western Manager Oliver United

Oliver United Filters, Inc., announces the appointment of P. J. McGuire as Western Division Sales Manager with headquarters in San Francisco. Mr. McGuire was formerly with the company in its Los Angeles office and takes the position formerly held by J. A. Lane, resigned.

▼

## W. M. Gross Appointed District Sales Manager International Filter Co.

Wm. M. Gross has recently been appointed District Sales Manager of International Filter Company of Chicago. Mr. Gross was former manager of the Water Treatment Division of Graver Tank and Manufacturing Company. He will take charge of the territory covered by the state of Ohio and eastern Michigan with headquarters at The Westlake, Cleveland, Ohio.

# GET YOURSELF A COPY OF THE DOSAGE CHART BEFORE THEY'RE ALL GONE

GREAT WESTERN ELECTRO-CHEMICAL CO · BEAR BRAND PRODUCTS · SAN FRANCISCO CALIF

A few of the Chemical Dosage Charts are still available but they're going fast. Waterworks men find they do cut out pencil work and are actually saving chemicals for them. With the simple directions for its use printed on the back of the chart, it is easy to find at a glance, with utmost practical accuracy, the relative dosage figures corresponding to any given quantity in pounds per million, parts per million or grains per gallon.

As long as the supply lasts, Great Western Electro-Chemical Co. will gladly send you, free of charge, a copy of this helpful time and chemical saver. Write for yours before they are gone.

## GREAT WESTERN ELECTRO-CHEMICAL CO.

9 Main Street, San Francisco · Plant: Pittsburg, California · 4151 Bandini Boulevard, Los Angeles

LFC

## Another Super-de Lavaud
### *Installation by "Lynchburg"*

Invariably—the Lynchburg Foundry trade mark rates high with Engineers and Contractors who have built enviable reputations . . . Excellent Foundry Technique, Prompt Service, and Equipment to produce the UNUSUAL and DIFFICULT are in no small measure responsible for this high rating . . . Regardless of whether your requirements are large or small—Write, Wire or Phone "Lynchburg" for quick estimates.

Bell and Spigot Pipe and Fittings. From 4" to 54".
Cast Iron Flanged Pipe. From 3" to 84".
Cast Iron Flanged Fittings and Flanges. From 1" to 84".
Super-de Lavaud Centrifugal Cast Iron Pipe.

Special Iron Castings for the Chemical Industry

LYNCHBURG FOUNDRY COMPANY

Peoples Gas Building Chicago, Ill. · GENERAL OFFICE - LYNCHBURG, VIRGINIA · Empire State Building New York, N. Y.

# DIRECTORY OF ENGINEERS

Aerial Mapping Since 1922

## ABRAMS AERIAL SURVEY CORP.

Contractor to Federal, State, County and Municipal Government Depts., Large Corporations—Private and Industrial Interests

WE HAVE MAPPED FROM THE AIR 61 MUNICIPALITIES
AN ENGINEERING SERVICE CONTINUED AERIAL SURVEY MAPS
Highways, Transmission Lines, Pipe Lines, City Zoning and Tax Maps, Timber Cruises.
Send for our Folder—"The Third Dimension in Aerial Photography"
Submit Projects for Contract Prices Lansing, Michigan

### Alvord, Burdick & Howson

Engineers
John W. Alvord, Charles B. Burdick, Louis R. Howson, Donald H. Maxwell.
Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation.
Civic Opera Building, Chicago.

### C. M. Baker

Consulting Engineer
Specializing in Industrial Waste Utilization and Stream Pollution Problems.
Investigations, Reports, Estimates.
2 So. Carroll St.,
Madison, Wis.

### Black & Veatch

Consulting Engineers
Sewerage, Sewage Disposal, Water Supply, Water Purification, Electric Lighting, Power Plants, Valuations, Special Investigations, Reports and Laboratory.
E. B. Black, N. T. Veatch, Jr.
Mutual Bldg.,
Kansas City, Mo.

### Burns & McDonnell Engineering Co.

McDonnell-Smith-Baldwin-Lambert
Consulting Engineers
Waterworks Sewerage
Lighting Appraisals
Rate Investigations
Kansas City, Mo., 107 W. Linwood Blvd.
Western Pacific Bldg., Los Angeles, Cal.
Dixie Terminal Bldg., Cincinnati, Ohio.

### The J. N. Chester Engrs.

J. N. Chester
J. F. La Boon
D. E. Davis
J. T. Campbell
E. B. Bankson
Consulting Hydraulic, Sanitary and Valuation Engineers.
Clark Bldg., Pittsburgh, Pa.

### Chicago Testing Laboratory, Inc.

and affiliated
Chicago Paving Laboratory, Inc.
Consulting and Inspecting Engineers
Hugh W. Skidmore
Gene Abson
Materials, Processes, Structures, Consultation, Inspection, Testing, Design, Research, Investigation and Experts in Litigation.
536 Lake Shore Drive, Chicago.

### H. Burdett Cleveland

Consulting Sanitary Engineer
Water Supply and Purification, Sewerage and Sewage Disposal, Refuse Disposal, Treatment of Industrial Wastes, Design, Reports, Consultation, Investigation, Evaluation of Works, Supervision of Construction.
90 Wall St.,
New York City.

### G. Gale Dixon

Consulting Engineer
Water Works—Sewerage.
Home Savings and Loan Bldg.,
Youngstown, Ohio.

### Fowler, Charles Evan

Consulting Civil Engineer
M. I. Am. C. E.
M. Eng. Inst., Can.
BRIDGES AND ARTISTIC STRUCTURES.
FINANCING FOR GOOD PROJECTS.
5 West 63rd St., New York.

### Fuller & McClintock

Engineers
F. G. Cunningham
C. A. Emerson, Jr.
Elmer G. Manahan
W. Donaldson
Ernest W. Whitlock
H. K. Gatley
Sewage Treatment, Sewers, Waterworks, Water Purification, Drainage, Waste Disposal, Valuations.
11 Park Place, New York

### Nicholas S. Hill, Jr.

Consulting Engineer
Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design, Construction, Operation, Management, Chemical and Biological Laboratories.
112 East 19th St., New York.

### A. Elliott Kimberly

Consulting Sanitary Engineer
Water Supply, Water Purification, Water Softening, Sewerage, Sewage Disposal, Sewage Treatment, Waste Treatment. Specialists in Milk and in Canning Waste Treatment.
568 East Broad St., Columbus, Ohio.

### Morris Knowles, Inc.

Engineers
Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning.
Pittsburgh, Pa.

### Metcalf & Eddy

Engineers
Water, Sewage, Drainage, Refuse and Industrial Wastes Problems, Laboratory, Valuations.
Statler Bldg., Boston.

### Malcolm Pirnie

Engineer
Water Supply, Treatment, Sewerage Reports, Plans, Estimates.
Supervision and Operation. Valuation and Rates.
25 W. 43rd St., New York, N. Y.

### Potter, Alexander, C. E.

Hydraulic Engineer and Sanitary Expert
Sewerage and Sewage Disposal, Water Supply and Purification.
50 Church St., New York.

### Sheppard T. Powell

Chemical Engineer
Treatment of Water for Industrial Uses.
Trade Waste Investigations and Correction.
Technical Expert in Litigations.
330 N. Charles St.,
Baltimore, Maryland.

### Astrid S. Rosing, Inc.

Sewer Pipe.
Drain Tile.
Steam and Electric Conduits.
Building Tile.
Fire Brick.
2417 Orchard St.,
Chicago, Ill.

### P. H. Taylor Audit Co.

Municipal Accountants and Auditors
Audits.
Systems.
Budget Preparation.
Investigations.
267 Highland Ave., Buffalo, N. Y.

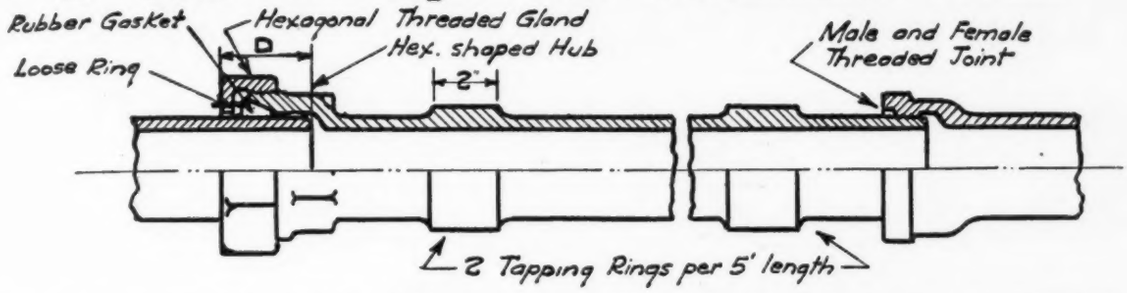
### Whitman & Howard

Harry W. Clark
Associate Engineers
(Est. 1869—Inc. 1924)
Channing Howard
Paul F. Howard
Walter A. Janvrin
C. Roger Pearson
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

### P. S. Wilson

Consultant in Sanitary and Hydraulic Engineering.
Water Works Management.
Glen Ridge, N. J.

## 2" Cast Iron Pipe With Mechanical Joints




Size, 2"; O. D. (same as steel) 2.375"; weight per foot including joint, 6 lbs. Combines the well-known longevity of cast-iron pipe with the construction advantages of a widely deflectable (8 degrees) yet bottle-tight joint. Known as "Monoloy MJ Piping." For literature write American Cast Iron Pipe Co., Birmingham, Alabama.

## ODOR DETERMINATIONS

On a Numerical Basis by the Threshold Method Using

## FAIR-WELLS OSMOSCOPES

Type A

Type B

Apparatus for use both by liquid and air dilution methods.

Write for bulletin No. 524, which gives full information and prices.

Advise us of your laboratory requirements.

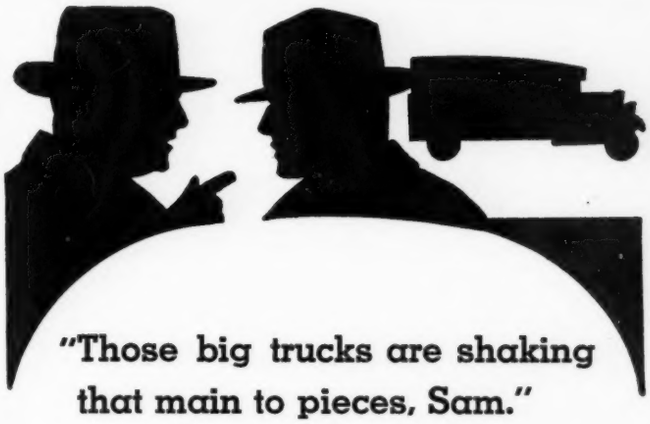
**EIMER & AMEND**

Est. 1851. Inc. 1897

**HEADQUARTERS FOR LABORATORY APPARATUS AND CHEMICAL REAGENTS**

**Third Ave., 18th to 19th St.**

**NEW YORK, N. Y.**



"Those big trucks are shaking that main to pieces, Sam."

"Better change to Reading GPWI* Pipe, Ed. It can take it."

*GPWI—Genuine Puddled Wrought Iron

*For advice in picking the right pipe for the right spots, write*

READING IRON COMPANY
PHILADELPHIA

SCIENCE AND INVENTION HAVE NEVER FOUND A SATISFACTORY SUBSTITUTE FOR GENUINE PUDDLED WROUGHT IRON

## Belle Alkali Company

LIQUID CHLORINE — BRAND — CAUSTIC SODA

CHARLESTON, W. VA.

CHLORINE PRODUCTS

PLANT: BELLE, W. VA.

WE SPECIALIZE IN PURE WATER WORKS CHLORINE — WRITE FOR QUOTATIONS

THE TYPE RF-6

# TERROMETER

*Patent Pending*

A "WIRELESS" PIPE LOCATOR

Representing the most modern means for locating buried pipes and conduits. No wires need be attached to the pipe or earth. Completely self-contained.

ECONOMICAL AND SIMPLE TO OPERATE

Highly sensitive. Moderately priced. Write for Catalog G, which describes this most modern method of locating "lost" pipes and keeping your pipe line map up to date.

**ENGINEERING RESEARCH CORPORATION**

Suite 325, Giddens-Lane Bldg. Shreveport, Louisiana

# SIMPLEX

Simplex Indicating Recording Totalizing Meter Register

Venturi Type Meters

Effluent Controllers

Filtration Plant Gauges

Water Works Specialties

WRITE FOR BULLETINS

**SIMPLEX VALVE & METER CO.**

6743 Upland Street

Philadelphia, Pa.

## Dayton, Ohio, Buys a ROYER

At the plant where they sold so much sludge fertilizer that it was necessary to import sludge from a nearby city to meet the demand, a ROYER SLUDGE DISINTEGRATOR has been purchased. See Water Works & Sewerage page 439, Dec. 1933.

The complete machine with electric motor. Other models gasoline or belt drive.

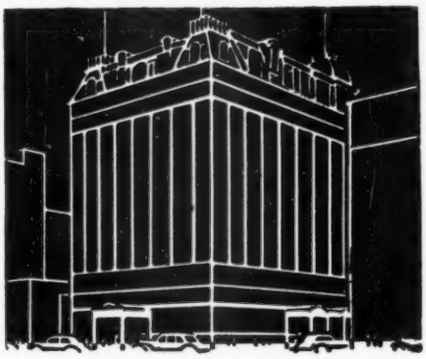
**ROYER FOUNDRY & MACHINE CO.**

KINGSTON, PENNA.

C. G. Wigley, Sole Agent

3108 ATLANTIC AVE. ATLANTIC, CITY, N. J.

IN PHILADELPHIA



**The Bellevue levels distances to theatres—shops—and social and business schedules . . . And when you come, Dinner and Supper Dancing in the Club Stratford in the Palm Room, of course, and perhaps appointments to be kept in the Cocktail Room, or in the Mandarin Grill.**

*Rates as low as $3.50.*

**BELLEVUE STRATFORD**

CLAUDE H. BENNETT, General Manager

INFILCO INTERNATIONAL

**Equipment—of Every Type and Size**
**—for Every Requirement of**
**—Modern Water Purification**

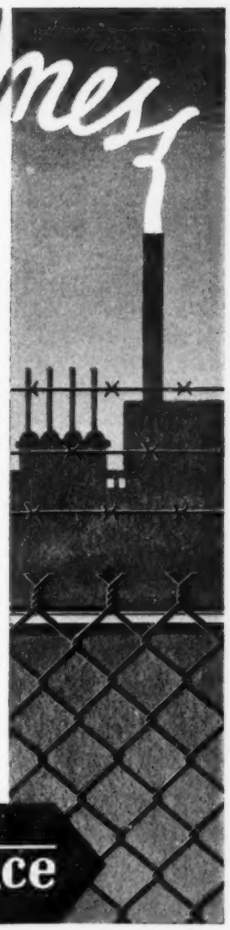
Aerators
Chemical Feeders
Chemical Proportioners
Directional Flow Controllers
Filter Plant Gauges
Flow Indicators
Gravity & Pressure Filters
Hydrodarco Purifiers
Level Controllers
Lime Slakers
Operating Tables
Recarbonating Equipment
Rate of Flow Controllers
Sampling Tables
Underdrain Systems
Venturi Tubes and Meters
Water Softeners

*The Infilco Equipped Water Purification Plant Centralizes Equipment Responsibility and Assures Coordinated Results*

**International Filter Co.**
59 East Van Buren Street, Chicago

INFILCO INTERNATIONAL

Preparedness

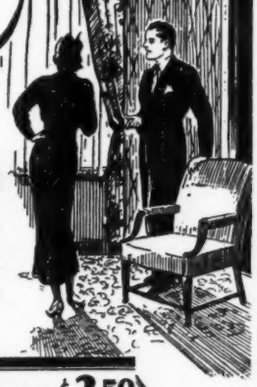


● When and if an emergency comes, a fence around your property becomes your first line of defence. Be prepared. Build your fence now. A representative for Pittsburgh Chain Link Fence will gladly lay out a fence plan and furnish an estimate of cost without obligation on your part. You will find a Pittsburgh Fence well worth its cost. Built to strict specifications, it will give positive protection and last for many years to come. Write for illustrated catalog.

**PITTSBURGH STEEL CO.**
PITTSBURGH • PENNA.

**Pittsburgh Fence**

Spacious Comfort



**IN CHICAGO**

Auditorium hotel rooms are large, spacious and comfortable with beds that were really made for restful slumber.

WITH PRIVATE BATH FROM $2.50
WITHOUT PRIVATE BATH – $1.50

Live on Michigan Avenue, close to the Loop, when you visit Chicago. Enjoy the traditional luxury of the Auditorium Hotel—yours now at an extremely moderate cost.

GEO. H. MINK, Mgr.

**AUDITORIUM Hotel**
MICHIGAN AVENUE AT CONGRESS ST.

**"ISCO" Ferric Chloride**

**In the Filter Plant** it is an effective and economical coagulant.

**Ferric Chloride** works fast—requires less mixing and settling time.

**In the Sewage Plant** it is an aid to rapid sludge drying. Applied to crude sewage it will increase settling tank efficiencies and reduce loadings on sprinkling filters and other secondary units.

**Ferric Chloride** treatment following sprinkling filters will produce a sparkling final effluent from humus tanks.

**"ISCO" CHLORINATED LIME**

For sterilization of water supplies or swimming pools, and for chlorination at sewage plants, provides a safe, convenient treatment with less total chlorine required.

**"ISCO" SERVICE**

We have a sanitary chemical engineering staff, experienced through wide contacts and successful installations. May they contribute their experience and information to your problem?

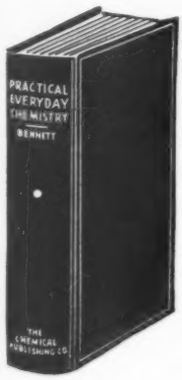
DISTRIBUTORS OF "CLIFF-CHAR" ACTIVATED CARBON

*Write for full particulars*

**INNIS, SPEIDEN & CO.**
INCORPORATED
117 LIBERTY STREET, NEW YORK.
Established 1816

# *It's here at last—*

## "PRACTICAL EVERYDAY CHEMISTRY"




More than 300 pages (5½ x 8¼). Contains hundreds of priceless formulas. One formula alone may save you many dollars or start you in an interesting business or life-work.

It is the only modern book of its kind available. Only a large printing has made it possible to turn out such a storehouse of up-to-the-minute information at such a low price.

Why not apply yourself to the practical chemistry of the many things which you use or see daily? As for a laboratory, the attic, kitchen, basement or garage will answer.

Many of the things you use in your daily life are effectively disguised under widely advertised trade names. "What are their compositions? How are they made?" you are prone to ask yourself. Such things are mysteries to many; and even those who have had college educations must feel woefully ignorant in this respect.

To cite a few more examples: Ask yourself what you know regarding the compositions or methods of making—

*Adhesives, Alloys, Animal Remedies, Antifreezes, Antiseptics, Automobile Specialties, Blacking, Bleaches, Bakery Preparations, Carbon Paper, Cements, Colors, Cosmetics, Crayons, Disinfectants, Drugs, Dyeing, Emulsions, Extracts, Fireproofing, Fireworks, Garden Specialties, Greases, Inks, Insecticides, Liquors, Mouth Washes, Paints, Plating, Polishes, Soaps and Cleaners, Stain Removers, Varnishes, and many other things too numerous to mention.*

Hundreds of other articles with which you are in daily contact in office, factory, school, and home, may likewise be unsolvable mysteries to you.

## Price $2.00

### FREE EXAMINATION OFFER

**Gillette Publishing Co.,**
**400 W. Madison St., Chicago, Ill.**

Gentlemen:

Please send me postpaid "Practical Everyday Chemistry." In 10 days I agree to return the book or remit $2.00 in full payment for the book.

Name .....

Position .....

Address .....

City ..... State .....

WW&S-1-35

# FILCLOR

Chlorine and Ammonia Control Apparatus

**The Filclor Company**

59th Street & Woodland Avenue, Philadelphia, Pa.

# FOR WATER WORKS and SEWERAGE PROJECTS

40,000 feet of 20" Naylor Spiralweld lock-seam Toncan steel pipe in 40' joints, with or without Victraulic couplings. Used two years, good as new; offering special bargain, $1.00 per foot, Oklahoma City.

*Wire—Write or Phone*

**SONKEN-GALAMBA CORPORATION**

*Personal Service—W. C. Berry*

**64 North Second Street** **Kansas City, Kansas**

## CLEARING HOUSE

### TRANSITS AND LEVELS

Largest stock in UNITED STATES of guaranteed **Rebuilt Transits** and **Levels** for RENT (with purchase option) or for SALE (on easy payment plan if desired). Every instrument repaired in our own factory. Sold subject to field test.

Complete and economical REPAIRS to your instrument regardless of make—by expert **instrument makers.** Shipping container on request. Estimates free. Your instrument deserves factory service.

Write for new descriptive list and rental schedule WWS-91.

**WARREN-KNIGHT CO.**

**Makers of Sterling Surveying Instruments.**

**Headquarters for Field Equipment and Drafting Room Supplies.**

**136 North 12th Street** **Philadelphia, Pa.**

**Patents and Trade Marks!**

Protect your most valuable assets.
Expert service. Prompt attention.

**LESTER L. SARGENT**

**Registered Patent Attorney**

**1115 K St. N W** **Washington, D. C.**

# THE SURVEYOR and Municipal and County Engineer

has been established for 40 years and is known throughout the world as the chief authority on *Roadmaking, Sewerage* and all other *Municipal Work.*

Advertisers regard it as an excellent medium for attracting business and public authorities use its columns to make known their requirements.

**Published every Friday, price 12 cents.**
**Annual Foreign Subscription, 8 dollars.**

*A specimen copy sent free upon application to the publishers,*

**ST. BRIDE'S PRESS, Ltd., 14 Bride Lane, Fleet Street, London, England**

THE NATIONAL METHOD
of Water Main Cleaning
20 Years Experience
*Write for Booklet*
"The Cleaning of Water Mains"
National Water Main Cleaning Co.
32 Church St. New York

ARROWHEAD
GRATING *and* TREADS
For Safety, Strength, Durability and Beauty.
*Catalog and quotations on request.*
Arrowhead Iron Works
Kansas City, Mo.

ROBERTS
FILTER MANUFACTURING CO.
607 Columbia Ave., Darby, Penna.
Manufacturers of Pressure and Gravity Type Water Filters and Specialties for Water Purification and Sewage Treatment Plants.
We contract for complete installation of mechanical and hydraulic equipment in all forms of Water Filtration Plants, Sewage Disposal Plants and Pumping Stations.
*Write us concerning your Sanitary Problems.*

pH AND CHLORINE CONTROL
ONLY GLASS STANDARDS *are always* ACCURATE
Noted authorities and all leading firms of the water supply field are using the Hellige non-fading, and, therefore, permanently reliable, glass standards and handy Hellige Comparators as they offer exclusive features and unequalled advantages. More than 500,000 standards now in use. Approved and highly recommended. One apparatus for chlorine, pH control, and many other popular tests.
Write today for detailed information.
HELLIGE, INC.
179 EAST 87th STREET, NEW YORK, N.Y. U.S.A.

SANI-TITE
SEND FOR FREE BOOKLET ON THE SAVING TO BE MADE *with this* MORE DEPENDABLE SEWER JOINT COMPOUND
HYDRAULIC DEVELOPMENT CORPORATION
Sales Office 50 Church St. New York City

LOCAL WORK for MORE LOCAL WORKERS
LOCAL labor is not only used for the laying but also for the manufacturing of Lock Joint Pressure Pipe, thus greatly relieving the local unemployment problem.
Lock Joint Pipe Co. Est. 1905. Ampere, N. J.
LOCK JOINT
REINFORCED CONCRETE PIPE
PRESSURE · SEWER · CULVERT

STREET, SEWER AND WATER CASTINGS

Made of wear-resisting chilled iron in various styles, sizes and weights.
*Write for Catalog and Prices*
SOUTH BEND FOUNDRY CO.
*All Kinds of Gray Iron Castings* SOUTH BEND, INDIANA

*Use* LAMOTTE EQUIPMENT *for*
pH Control—Residual Chlorine Control
Boiler Feed Water Control
LAMOTTE CHEMICAL PRODUCTS CO.
442 Light Street, Baltimore, Md.

USE
MINERALEAD
For Jointing Bell and Spigot Water Mains
Easy handling, ingot form—Impervious to moisture—Absolute uniformity—Easy melting—Rapid pouring—No caulking—Less initial leakage—Bell holes unnecessary—A saving in cost of material and labor.
Write for Catalog
THE ATLAS MINERAL PRODUCTS COMPANY
of Pennsylvania
MERTZTOWN PENNSYLVANIA
Established 1892
*G-K Sewer Joint Compound*

EDSON'S NEW HAND PUMP
Smallest Diaphram Pump Made. 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.
THE EDSON CORP'N, 49 "D" Street
So. Boston, Mass.
NEW YORK: 142 Ashland Pl., Brooklyn
CHICAGO: 3500 N. Long Ave.
*Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories*

# ADVERTISERS IN THIS ISSUE


A

Abrams Aerial Survey Corp. 46
Alvord, Burdick & Howson. 46
American Cast Iron Pipe Co. 47
Arrowhead Iron Works. 51
Atlas Mineral Products Co., The. 51
Auditorium Hotel. 49

B

Baker, C. M. 46
Belle Alkali Co. 47
Bellevue Stratford Hotel. 48
Black & Veatch. 46
Builders Iron Foundry. 10
Burns & McDonnell. 46

C

Carborundum Company. 5
Cast Iron Pipe Research Asso., The. 12
Chester Engrs., The J. N. 46
Chicago Pump Co. 10
Chicago Testing Laboratory, Inc. 46
Cleveland, H. Burdett. 46
Combustion Engineering Co., Inc. 7
Crane Company. 9

D

Dixon, G. Gale. 46
Dorr Company. Third Cover

E

Edson Corporation, The. 51
Eimer & Amend. 47
Electro Bleaching Gas Co. 11
Engineering Research Corp. 48

F

Filclor Company, The. 50
Filtration Equipment Corp. 8
Fowler, Charles Evan. 46
Fuller & McClintock. 46

G

Gillette Publishing Co. 50
Great Western Electro-Chemical Co. 45

H

Hellige, Inc. 51
Hill, Jr., Nicholas S. 46
Hydraulic Development Corp. 51

I

Industrial Chemical Sales Co., Inc. 6
Innis, Speiden & Co. 49
International Filter Co. 49

K

Kimberly, A. Elliott. 46
Knowles, Inc., Morris. 46

L

LaMotte, Chemical Products Co. 51
Lock Joint Pipe Co. 51
Lynchburg Foundry Co. 45

M

Metcalf & Eddy. 46

N

National Water Main Cleaning Co. 51

O

Oliver United Filters. 4

P

Pirnie, Malcolm. 46
Pittsburgh Steel Co. 49
Potter, Alexander. 46
Powell, Sheppard T. 46

R

Reading Iron Co. 47
Roberts Filter Mfg. Co. 51
Rosing, Inc., Astrid S. 46
Royer Foundry & Mach. Co. 48

S

Simplex Valve & Meter Co. 48
Sonken-Galamba Corp. 50
South Bend Foundry Co. 51

T

Taylor Audit Co., P. H. 46

U

United States Pipe & Foundry Co. Second Cover

W

Wallace & Tiernan Co. Back Cover
Warren-Knight Co. 50
Whitman & Howard. 46
Wilson, P. S. 46


## POSITIONS WANTED

***This department has been started as a service to those in the Water Works and Sewerage Fields. We hope they will make use of it. The notices are inserted without charge.***

WATER WORKS MANAGER — Engineer with 13 years' experience in all phases of water works operation and management of utilities; has served as manager of private water company and since as Town Manager. Position with large Water Utilities Corporation preferred, but equipped to serve municipality as Superintendent or Manager. Address "E. H. R.," care of Water Works and Sewerage, 420 Lexington Ave., N. Y. C.

SANITATION ENGINEER—B. S. in Sanitary Engineering from recognized engineering school; 15 years in actual design and operation water supply and purification and sewerage and sewage treatment. Complete references on character, ability and competency furnished at request. Available on thirty days' notice. Address M. S. E., % Water Works and Sewerage, 420 Lexington Ave., New York City.

SANITARY ENGINEER — Michigan State College, '34, age 24, married. Desires work in the sanitary field. Location immaterial. Address A. J. K., Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

CHEMICAL ENGINEER—M.S., age 26, married, 2 years indust., 3 years prof. chem. engr., 1 year chem. and bactr. consultation, wants job, plant or laboratory work. Reasonable salary with opportunity for advancement. Six weeks' notice required. Address Box 600, % Water Works and Sewerage, 400 W. Madison St., Chicago, Illl

CHEMIST, bacteriologist or operator of a sewage treatment or water purification plant. Four years' experience as chemist at the Southerly Sewage Treatment Works of Cleveland, O., and previous to that in the laboratories of the Baldwin Filtration Plant of same city. Can furnish excellent references. Graduate of Western Reserve University and just completed a year of graduate work at Ohio State University in Bacteriology and Chemistry. Address F. W. G., % Water Works & Sewerage, 400 W. Madison St., Chicago, Ill.

CIVIL ENGINEER—C. E. Rensselaer Polytechnic Institute, '34, age 24, single. Desires work of any nature qualified for. Location immaterial. Available immediately. Especially interested in Water and Sewage projects. Address, "E. D. B.," % Water Works and Sewerage, 420 Lexington Avenue, New York City.

CIVIL ENGINEER—B. S. in Civil Engineering '34; age 24. Location immaterial. Desires work of any nature qualified for. Four years' experience previous to graduation—two years jr. draftsman in steel fabricating office, two years in N. Y. S. highway dep't. References. Available immediately. Address Andrew D. Korin, 709 W. Maumee St., Angola, Indiana.

SUPERINTENDENT OR MANAGER of water works. 12 years in management of all details and meters, pipe lines, wells, pumps, engines and electric motors. Ready on two weeks' notice. Married. Age 52. Address C. I., Water Works & Sewerage, 400 W. Madison St., Chicago, Ill.

SANITARY ENGINEER-CHEMIST—Graduate (C. E.), with 17 years' experience in design, construction, and operation of water purification plants and sewage treatment works. Experienced also in swimming pool sanitation and milk control. Can manage or superintend the operation of a water works or sewerage system. Address E. R., % Water Works and Sewerage, 420 Lexington Avenue, New York City.

GRADUATE CIVIL ENGINEER, Univ. Michigan, 1932, specializing in Sanitary Engineering. Age 25. Experience as assistant in sanitary inspection of water supply, analysis sewage and sewage gas, determination source of odors in sewer system, gaging of sewers and streams. Now conducting independent research on sewage and garbage. For references and further information address G. W. H., % Water Works and Sewerage, 420 Lexington Ave., New York City.

JUNIOR CIVIL ENGINEER — University graduate; single; age 26; seven months' drafting experience. Desires engineering position with civil or sanitary engineer, or with an engineering corporation. Salary and location open. Address "C. F. D.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

CIVIL ENGINEER—B.C.E. Polytechnic Institute of Brooklyn '34, age 22, single. Desires work of any nature qualified for. Location immaterial. Available immediately. Address "I. A.." % Water Works and Sewerage, 420 Lexington Ave., New York City.

SANITARY ENGINEER—B. S. in Civil Engineering with Sanitary Engineering option. N. Y. U., '34; age 21. Desires work in the sanitary field. Location immaterial. Available immediately. Address W. M. S., % Water Works and Sewerage, 420 Lexington Ave., N. Y. C.

WATER WORKS ENGINEER-MANAGER —20 years' experience in design construction, operation and management. Available after July 15th. Address "A. C.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

GRADUATE CIVIL ENGINEER, 34, 12 years' experience in sanitation and water supply, 6 years in charge of work, including reports, design, specifications, estimates, financing, etc., desires association with municipal engineer or land surveyor. Address P. B., % Water Works & Sewerage, 400 W. Madison St., Chicago, Ill.

# Dorrco Doings in 1934

Leonor F. Loree, the famous railroad president, remarked at a college board meeting we were attending, that there is a French proverb which says "It is more dangerous to do good than evil, for if you start to do evil you have your conscience as a guide to hold you back, but if you start to do good, there is nothing to restrain you." Events in Washington during the past two years have impressed this most deeply upon me as upon many students of history and economics.

At a meeting of an editorial advisory board recently, a member stated that a study of political, economic and social trends in this country in the light of world history, had led his organization to the conclusion that within six years the '34 price level would increase five fold.

Elected officials blow loud blasts against the power companies, while the meek citizen writes to his paper, "My light bill for a family of three ten years ago was $3.48 a month; now, for five, it is $3.57. My taxes were $80; now they are $256. Please tell me who is robbing me."

The past year has been an eventful one for our company, for we have recognized changing conditions. Heeding James Harvey Robinson's appeal to see things as they are, not as they were nor as we should like to see them, we and our friends in San Francisco have adjusted our relationships happily, leaving them to carry on our former filter business in this country and us to handle their business on the other side.

The energizing effect of P.W.A. appropriations on municipal improvements has resulted in the extension of our sanitary work to a greater number of cities than ever before.

THE THIRTIETH MILESTONE

Last July many of our old friends who were engaged in mining in the early 1900's gathered together with us at our Westport, Connecticut, laboratory to celebrate the Dorr Classifier's 30th birthday.

Many an old friend reminisced on the early days in the West and many more wrote letters recalling the development of the Classifier and its contribution to metallurgy throughout the world.

CLASSIFICATION

The FX Classifier, designed to meet the demand for high circulating loads, is fulfilling the expectations of reduced grinding costs and improved metallurgy in the world's copper districts, and in the gold mills in Canada and the Philippines. Circulating loads of 1200% are an accomplished fact and a new installation is aiming at 2000%.

CYANIDATION

Improvements have been directed toward greater flexibility in aeration and more compact equipment for the small gold mills. The aim has been to bring big mill standards of practice to the mill with the capacity of only 15 to 50 tons per day.

COMPACT THICKENERS

The new Centrepier and Type A Thickeners have no superstructures. The improved Balanced Tray Thickener provides full tray efficiency in shallow tanks. The Washing Tray Thickener gives the small operator a complete, C.C.D. plant in a single unit.

SANITARY ENGINEERING

The Dorr Sifeed Clarifier has demonstrated the advantages of mechanical simplicity combined with central sub-surface feed and peripheral overflow. Chicago's new Calumet plant has 15 of them, installed in 91-foot square tanks; Cleveland's Easterly plant has 16, each 112 feet in diameter.

The Dorrco Flocculator has proved its adaptability to both old and new water plants. Improved flocculation has reduced chemical consumption and increased settling and filtration.

SOUTHERN CHEMICALS

Among the pulp producers using our Continuous Causticizing System are Brown, Bogalusa and Southern Kraft. All of the three Gulf Coast alkali plants use our equipment for caustic soda manufacture—Southern Alkali, Mathieson and Solvay.

PHOSPHATE FLOTATION

The flotation process has been adopted by the principal phosphate rock producers in the South, with marked increase in recoveries. Our equipment has been installed in all of these plants.

COOPERATION AND RESEARCH

A cement company conceived the idea of preparing its mix by the subtraction of an excess constituent from its rock instead of adding other materials. Our research pointed the way to a method which was jointly carried through a pilot plant and into a successful commercial unit, which incidentally has cut quarrying costs in half.

BEET SUGAR

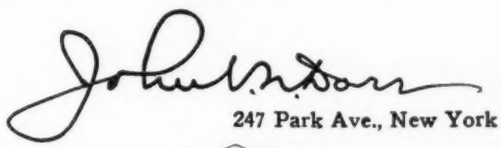
Our Continuous First Carbonation Process is now being used in America for the treatment of approximately 4,000,000 tons of beets annually.

EUROPE

Twice during 1934, I visited Europe in connection with the excellent work being done there by associates in London, Paris, Berlin and The Hague. The work abroad is diversified, including pulp in Scandinavia, sewage in England and the Netherlands, water in France, mining in Africa, lithopone in Italy and phosphoric acid in Germany and Greece.

Hard work, tightened belts, and a veteran staff have brought their rewards to our company this year, and financial recognition, moderate to be sure, to each of us. We are taking our lessons of the past to heart and are moving ahead on all fronts. The world ahead may be a different one, but we shall adjust ourselves to it and "pull our weight."

On behalf of all of us, I extend the Season's Greetings to our friends everywhere in so many lines of industrial endeavor.



247 Park Ave., New York

DORRCO

# FAMOUS VICTIMS OF WATER-BORNE DISEASES . .

## LOST *to the* Country's Highest Office

## Zachary Taylor, *12th President of the U. S. A.*

WHEN in 1850, with scarcely half his term of office served, Zachary Taylor (famous Indian fighter, victorious invader of Mexico, successful candidate for his country's highest honor—12th President of the U. S.) succumbed to typhoid fever, one hundred people out of every hundred thousand met death from this preventable water-borne disease every year!

Today, with 85% of the nation's drinking water chlorinated, annual typhoid death rates approximate TWO in every hundred thousand and eighteen careful cities went through the whole of 1933 WITHOUT A SINGLE DEATH FROM TYPHOID.

Something more than mere coincidence must explain why seventeen out of these eighteen cities depend on W & T Visible Vacuum Chlorinators for successful chlorination, at an average cost of less than a penny per person per year—and why close to seven thousand other American municipalities relying on W&T Chlorinators agree with us that "The Only Safe Water Is a Sterilized Water."

*There is a W&T Chlorinator for every chlorinator purpose. Send us a description of your supply and we will, without obligation on your part, select the one most suited to your needs.*

## WALLACE & TIERNAN CO., Inc.

*Manufacturers of Chlorine and Ammonia Control Apparatus*

NEWARK, NEW JERSEY Branches in Principal Cities...Main Factory, Belleville, N. J.